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FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE
PROPOSED EXPANSION OF WESTMORELAND RESOURCES INC.
ABSALOKA MINE
INTO
SECTION 36, T1N, R37E

MONTANA DEPARTMENT OF STATE LANDS
HELENA, MONTANA

Submitted pursuant to
Montana Environmental Policy Act

MAY 23 '79

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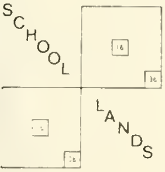

December 23, 1977

The Absaloka mine area is located in Big Horn County, Montana, within the Crow Indian Reservation "Ceded Area". Westmoreland Resources is proposing to expand the mine into State Section 36.

This final EIS represents a cooperative effort by this Department's Environmental Coordinator staff and members of the Department's Coal Bureau. Many state agencies and individuals also contributed by commenting on the draft EIS which was issued on June 24, 1977.

Contents of the EIS are based on the requirements set forth in the Montana Environmental Policy Act (MEPA), (Chapter 65, Title 69, R.C.M. 1947) and departmental rules adopted pursuant to MEPA (Title 26, Chapter 2, Subchapter 18 of MAC).

All material submitted to the Department by Westmoreland as part of their application for a permit pursuant to the requirements of the Montana Strip Mining and Reclamation Act (Chapter 10, Title 50, R.C.M. 1947) are on file and available for public review in the Department's offices.

Sincerely,

David N. Janis

David N. Janis
Environmental Coordinator

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I. INTRODUCTION

A. The proposed action

The Department of State Lands (DSL) administers the Montana Strip and Underground Mine Reclamation Act (Title 50, Chapter 10, R.C.M. 1947). The Reclamation Act specifies that, "An operator may not engage in strip or underground mining (for coal or uranium) without first having obtained from the Department a permit . . . ." (Section 50-1039). Strip mine permits issued after July 1, 1977 will be for five years at a time and then must be renewed upon application to the Department. Until then permits will be issued on a due-year basis.

On June 8, 1976, Westmoreland submitted a surface mining permit application to DSL. Westmoreland is seeking to expand their Absaloka coal mine south into Section 36, T.1N., R.37E. [1/] Coal and surface rights to Section 36, T.1N., R.37E., are owned by the State of Montana. Westmoreland's proposed mining plan which shows both the existing and proposed mine areas is shown in figure 2.

The Montana Environmental Policy Act (MEPA) requires that Environmental Impact Statements (EIS) be prepared on "proposals for projects, programs, legislation, and other major actions of state government significantly affecting the quality of the human environment." (Section 69-6504, R.C.M. 1947) Pursuant to MEPA, the Department determined that permitting the expansion of Westmoreland's Absaloka Mine into Section 36, T.1N., R.37E. is a major action significantly affecting the quality of the human environment and hence requires that a draft EIS be prepared on the proposed action.

[1/] associated mine disturbance including a topsoil stockpile is also proposed for portions of Section 35, T.1N., R.37E., (see figure 2).

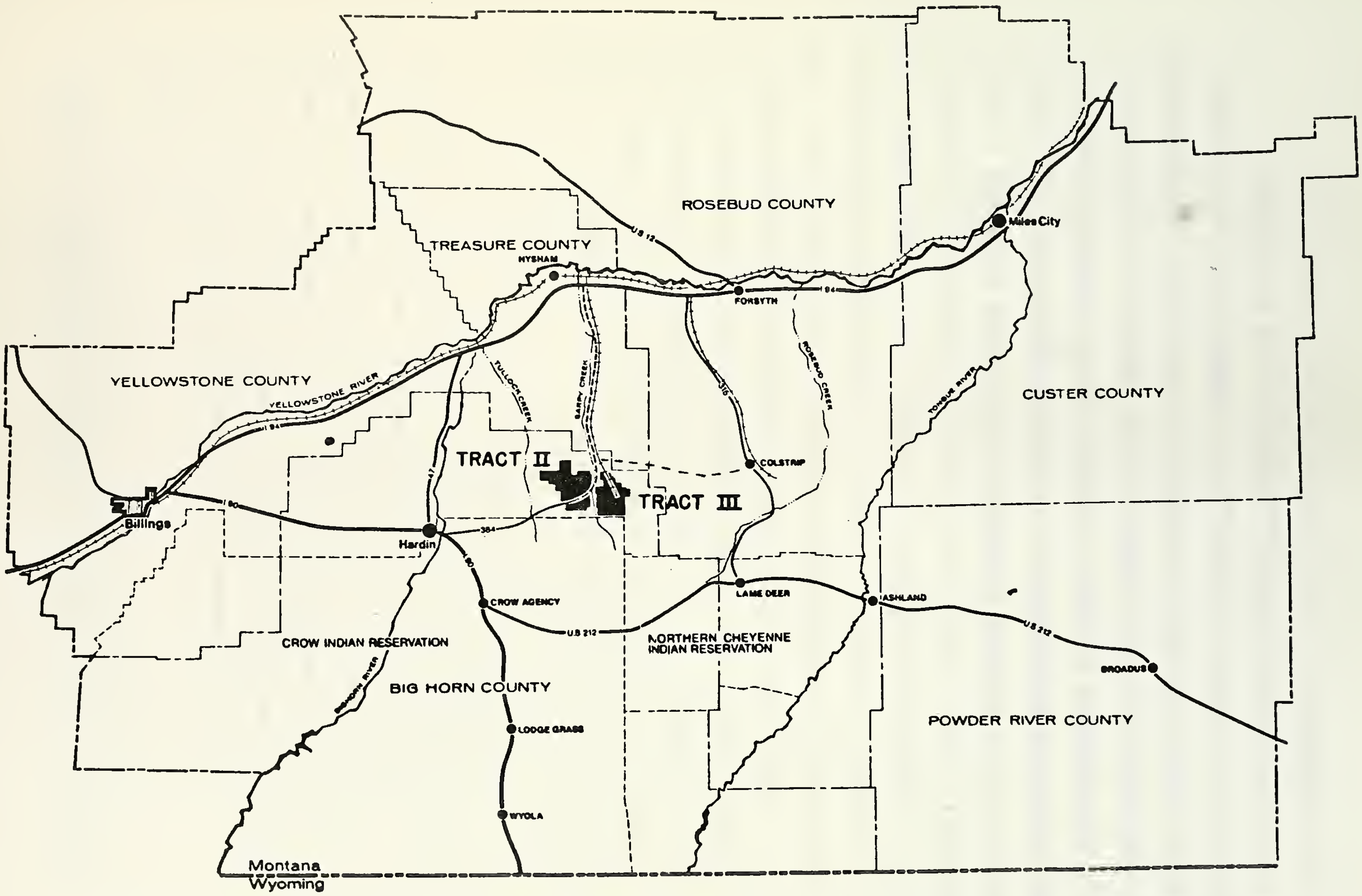

Figure 1.--Location of Westmoreland leases, Tract II and Tract III, Big Horn County, Montana (Mountain West Research, 1975)

B. Location

The Absaloka mine area is located in Big Horn County, Montana, and is within the Crow Indian Reservation "Ceded Area". The ceded area is situated immediately north of the Crow Reservation and south of the Yellowstone River (figure 1). Principal access is via state secondary highway 384 from Hardin, Montana, which is located approximately 26 miles to the west. The Absaloka mine is located within Crow Coal Lease Tract III (figure 1).

C. Other environmental assessments for the Absaloka Mine

Two Environmental Impact Statements (EIS) regarding expansion of the Absaloka mine have recently been distributed by agencies of the federal government. In December 1976, the U.S. Bureau of Indian Affairs issued a Final EIS entitled "Crow Ceded Area Coal Lease Tracts II and III, Westmoreland Resources", and in November 1976, the U.S. Geological Survey issued a Draft EIS entitled: "Proposed 20-Year Plan of Mining and Reclamation, Westmoreland Resources, Tract III, Crow Indian Ceded Area, Montana".[1] The former statement reconsiders the Secretary of Interior's approval of existing coal leases between the Crow Tribe and Westmoreland Resources by analyzing the environmental impacts of three levels of coal development within the lease areas. The latter assesses the impacts of ultimately mining coal over 2,151 acres in Coal Lease Tract III. Both statements analyzed, in a broad sense, the impacts of mining the state-owned coal in Section 36, T.1N., R.37E.

In addition to these two assessments, the Montana Department of State Lands issued a Final EIS on Westmoreland's mine in 1973 entitled: "Administrative Action - Proposed Westmoreland Resources Sarpy Creek Mine - Big Horn County, Montana". Subsequent to this EIS, the Department of State Lands (1975a, 1976b) issued Preliminary Environmental Reviews (PER) of Absaloka mine expansions in November 1975 and November 1976.

---

[1] A final EIS on the 20-year mining plan was filed with the Council on Environmental Quality on May 31, 1977 and became final on June 30, 1977 (FES #77-17).

Recently the Forestry Division of the Montana Department of Natural Resources (1977) issued a P.E.R. for a proposed timber sale in Section 36, T.1N., R.37E. Such a sale would be necessitated should Westmoreland's pending application for strip-mining in Section 36 be approved.

Parts of the above mentioned environmental assessments are, where indicated, or not otherwise contradicted, incorporated by reference into this Draft EIS. Copies of such assessments are available for review in DSL's Helena offices.

D. Mine history

Description of Westmoreland Resources' Tract II and Tract III coal lease, the lease histories and the legal situation surrounding such are clearly described in the Final EIS (FES 76-64) distributed by the Bureau of Indian Affairs December 15, 1976 and the Final EIS (FES 77-17) of the U.S. Geological Survey on the Proposed 20 Year Plan of Mining and Reclamation, Westmoreland Resources' Tract III, distributed May 31, 1977. Such descriptions are herein adopted by reference.

A state coal lease for Section 36, T.1N., R.37E. was issued to Consolidation Coal Company by DSL on June 3, 1970 and assigned to Westmoreland Resources on July 13, 1973 (see Appendix A for a copy of Montana Coal Lease C-1047-70). The surface of Section 36 is leased to Mrs. Vella B. Redding under a state grazing lease dated February 28, 1973. Mrs. Redding has agreed to 6 months notice of withdrawal of her lease by DSL. Notice of potential withdrawal has been given.

Site construction of the Absolaka mine began in October 1972. In early 1974 the DSL issued a strip mining permit for the first year of mining and surface coal mining operations began shortly thereafter. This and subsequent DSL permits and permit amendments obtained by Westmoreland are listed in table 1 below:

Table 1.-- Surface mining permits and permit amendments issued to Westmoreland Resources[a]

Date issued[b]	Permit No.	Description
Feb. 1, 1974	74005	Original mine plan, power line, roads, etc.
Mar. 11, 1975	75005	Mine expansion
July 16, 1975	75005-A001	Power line
Dec. 4, 1976	75005-A002	Mine expansion, alternate mining plan
Mar. 9, 1976	76005	Mine expansion, additional roads, etc.
Nov. 24, 1976	76005-A001	Dragline erection site, emergency scraper pit
Jan. 24, 1977	76005-A002	Road change

(a) In compliance with Title 50, Chapter 10, R.C.M. 1947

(b) Prior to July 1, 1977, strip mine permits were issued for one year at a time and could be renewed annually upon application to DSL. After July 1, 1977, these time frames will convert to 5 years.

The Bureau of Indian Affairs (1976) final EIS for lease tracts II and III was approved on January 1, 1977, and the U.S. Geological Survey final EIS was approved on August 15, 1977 for Westmoreland's 20-year mining plan. Prior to this, the Absaloka mine had been confined to the original 770 acres.

Through March 1977, Westmoreland has mined approximately 10,443,000 tons of coal from their Absaloka mine. Past and projected annual production for the mine are as follows:

1974 - 1,457,673 tons

1975 - 4,048,082 tons

1976 - 4,083,894 tons

Commencing in 1977, due to limited working area in the existing mine permit area production would be shifted to the area immediately adjacent to the present operation in Tract III. This operation would extract over a 20 year period a maximum of 10 million tons annually commencing in 1981. Under alternative mining plan for the Tract III area an eventual production level of 15 million tons by 1989 could be attained.

E. Mining Plan

1. Description of the mineable coal seams

The mine area is underlain all or in part by four separate and distinct subbituminous coal beds that can be mined by surface methods. They are, in order of increasing depth, the Stray 1 coal, the Rosebud-McKay coal, the Stray 2 coal, and the Robinson coal (figure 3). All four seams represent economically mineable resources of subbituminous coal and lignite. The Stray 1 coal however, is of fairly poor quality and is difficult to mine because of considerable rolling and pitching of the seam. It is unknown therefore, how much of the Stray 1 can be recovered (see Section II. A. 1. for further discussion of the coal seams).

2. Mining sequence

A map depicting Westmoreland's mining plan for Section 36, T.1N., R.37E. is shown in figure 2. Figure 2 represents an alternate mining plan for Section 36. The original mining plan, submitted on June 8, 1976, was substantially revised at the request of DSL. The mining plan depicted in figure 2 was submitted on March 3, 1977.

Mining will generally proceed towards the east and will begin in the western one-half of Section 36 with the construction of incline No. 4 and the opening of a scraper pit. Following the removal of the Rosebud-McKay coal from the scraper pit, two short cuts (#1 and #2 on figure 2) would be mined. The 3rd cut and each successive cut thereafter would be initiated in the southern portion of Section 25 or northern portion of Section 36. The first six parallel cuts, as shown in figure

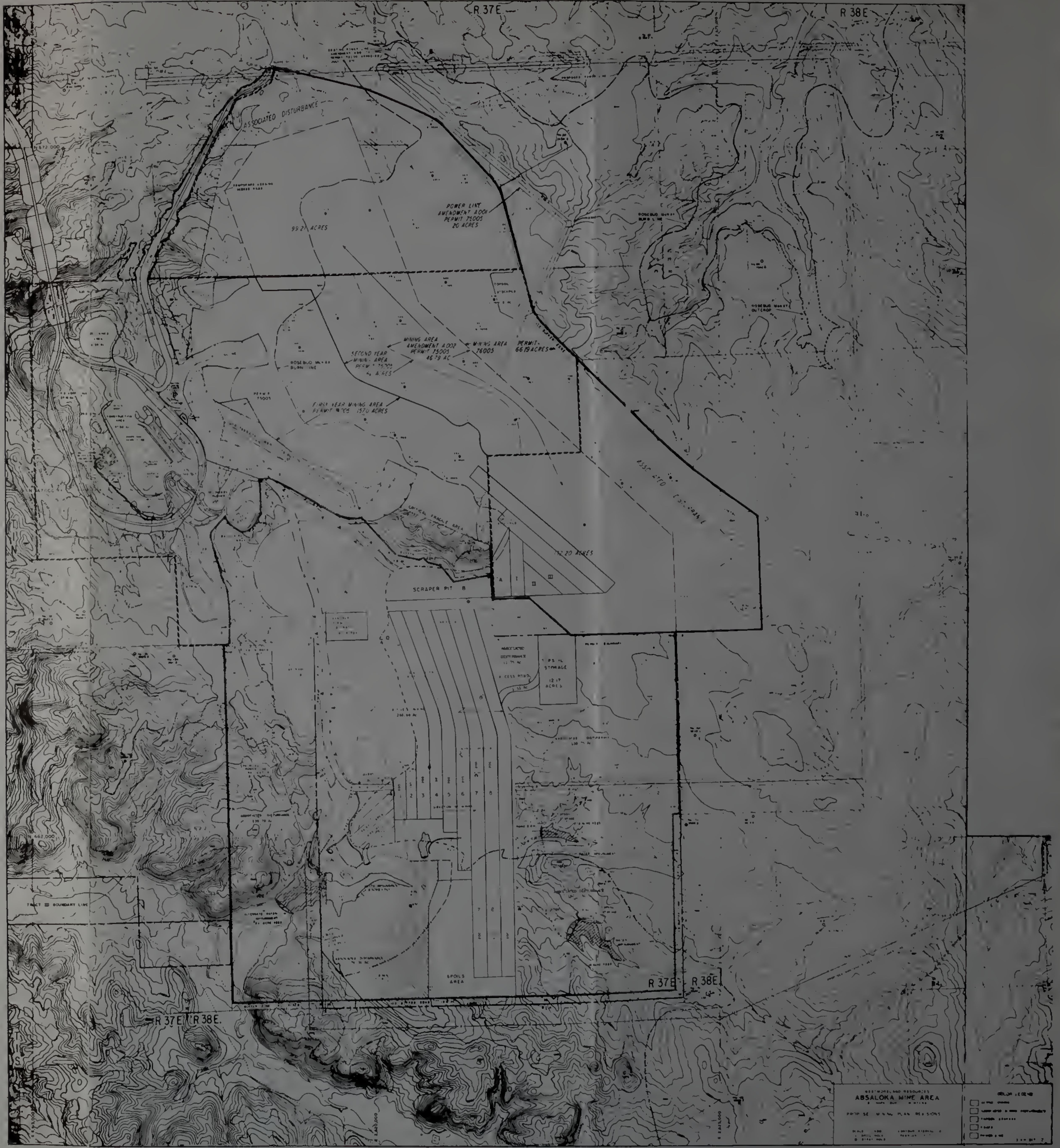

Figure 2.-- Westmoreland Resources proposed mining plan for Section 36, T.1N. R.37E. (submitted to DSL by Westmoreland Resources in March, 1977)

2, will be abbreviated in length, so as to protect an area of south-facing scoria slopes in the southwest corner of Section 36. These slopes are vegetated primarily with skunkbush and represent significant wildlife habitat. Under the original mining plan for Section 36 these areas would have been largely covered by spoil material.

Cuts No. 1-4 would not extend farther south than the Rosebud-McKay burn line and would recover only the Rosebud-McKay seam due to lack of spoil area. Cut No. 5 would also not extend south of the burn line but would be the first cut to recover both the Rosebud-McKay and Robinson seams. Only the south extension of cut No. 6 would not recover the Robinson seam, however, it will be recovered in the northern portion of the cut. Beginning with cut No. 7 mining would extend south of the Rosebud-McKay burn line with Westmoreland mining both seams to the north of the burn line and only one seam to the south of the burn line.

3. Soil and overburden removal and storage

Beginning with the earliest construction and continuing through the life of the mine, topsoil would be removed from all areas adversely affected by construction or by removal of overburden and placement of spoils.

Topsoil removed during the initial stages of mining and construction would be stockpiled. After sufficient areas have been mined, backfilled, and recontoured, topsoil removed in advance of mining would be transported and replaced on recontoured spoils in one operation, avoiding insofar as possible the need to stockpile. Figure 2 shows the location of topsoil stockpiles for the proposed mine area.

After removal of topsoil by scrapers, overburden would be drilled, blasted, and then removed by dragline. Overburden spoil from cut 1 will be placed north and east of Incline #4. Spoil from each successive scraper cut will be placed in the previous empty pit. Spoil from cut #1 would be placed in the mined out scraper pit area. Spoil from cut #2 would be placed in cut #1, and spoil from cut #3 would be placed in cut #2 in the southern portion and in the box cut spoils area east of Incline #4 in the northern portion.

4. Mining equipment

The size dragline utilized in Section 36 depends on the timing of the federal decision on Westmoreland's 20-year mining plan for the tract III lease area (see U.S. Geological Survey, 1976) in relation to the timing of DSL's decision for the Section 36 permit application.

Should federal approval on the 20-year mining plan occur before a state decision is made on the subject permit application for Section 36, Westmoreland would utilize their 75 cubic yard dragline to extend the box cuts from their existing mine area to the northwest or to the southeast into an area already approved for mining by the Department of State Lands (permit No. 75005-A002). Should state approval for the proposed (Section 36) mine plan be subsequently approved, Westmoreland would use a new 110 yard dragline in Section 36. Delivery for this dragline is scheduled for the fall of 1977; construction would occur at the dragline erection site in Section 25 that was permitted by DSL in November, 1976 (permit No. 76005-A001).

Should Westmoreland not receive federal approval for their 20-year mining plan prior to the time a decision is reached by DSL for mining in Section 36, Westmoreland proposes to move their 75 yard dragline from their existing pit into Section 36 until such time as federal approval for the 20-year mining plan is given and the second dragline was ready to begin operation.

Other equipment that could be utilized in the proposed mine area include (Westmoreland Resources, 1976a, and U.S. Geological Survey, 1976):

6+ motor scrapers
4 bottom dump trucks
3 D-9 bulldozers
2 D-8 bulldozers
1 grader
1 disc and seed drill
1 diesel coal drill
1 electric overburden drill
1 water truck

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. Physical environment

1. Geology

All of the existing and proposed portions of the Absaloka mine lie within a shallow depression of the Powder River Basin of Northern Wyoming and Southeastern Montana. Geologic history of the basin can be traced back to the Paleozoic era which occurred from 230 to 600 million years ago (table 2). Approximately 12,000 feet of sedimentary material have been deposited in the basin since the Cambrian period. This material is divided into eight units which correspond to individual rises and falls of an ancient sea (Wyoming Geological Association, 1965).

The youngest of these units is comprised entirely of tertiary aged strata and includes time-stratigraphic layers which are the same age as the major portion of the laramide mountain formation period. The Powder River Basin assumed its present configuration during this time.

Early in the Cenozoic era (The Paleocene), the Big Horn Mountains, the Black Hills, and the Laramide Mountains began to rise and in the process shed sediment into the swamplands of the surrounding basins. As a result, approximately 1,300 to 2,200 feet of clastic debris and organic material accumulated. Such material is represented today by the Fort Union Formation and consists, in descending order, of the Tongue River, Lebo, and Tullock members and comprises tan, yellow, and gray sandstone, siltstone, argillite, and coal (table 3).

Table 2. -- Geologic time scale
(Flawn 1970)

Era	*Period*	*Epoch*
Cenozoic	QUATERNARY (lasted 0-1 million years)	Recent Pleistocene
	TERTIARY (lasted 62 million years)	Pliocene Miocene Oligocene Eocene Paleocene
63 million years ago		
Mesozoic	CRETACEOUS (lasted 72 million years)	
	JURASSIC (lasted 46 million years)	
	TRIASSIC (lasted 49 million years)	
230 million years ago		
Paleozoic	PERMIAN (lasted 50 million years)	
	PENNSYLVANIAN (lasted 30 million years)	
	MISSISSIPPIAN (lasted 35 million years)	
	DEVONIAN (lasted 60 million years)	
	SILURIAN (lasted 20 million years)	
	ORDOVICIAN (lasted 75 million years)	
	CAMBRIAN (lasted 100? million years)	
600? million years ago		
Late Precambrian		
Early Precambrian		

Table 3. -- Geologic units of crow lease areas Tracts II and III and vicinity, Big Horn County, Montana
(Westmoreland Resources 1975a)

Age		Millions of Years	Name of Unit		Description	Thickness (in feet)
Quaternary			Alluvium		sand, gravel, silt, and clay	<80
Tertiary	Eocene	38	Wasatch Formation		tan and yellow sandstone, siltstone, and mudstone	not present
	Pal-eocene	57	Fort Union Formation	Tongue River Member	tan, yellow, and red sandstone, siltstone, and mudstone w/many coal beds	locally>600
				Lebo Shale Member	gray shale and gray to yellow sandstone w/minor coal	±150
				Tullock Member	yellow sandstone and shale	±300
Cretaceous		65	Hell Creek Formation		greenish yellow shale and yellow sandstone	±800
		70	Underlying marine-deposited strata thousands of feet thick			

Overlying the Fort Union Formation is the Wasatch Formation. The Wasatch Formation dates back to the Eocene epoch (table 2) and is composed of argillite and coal. Tertiary and quarternary period gravel and alluvium occur along major river valleys of Southeastern Montana, particularly that of the Yellowstone, where 13 terrace gravels of Oligocene to Holocene ages occur (Westmoreland Resources, 1975a).

Cretaceous and tertiary strata between the Big Horn Mountains and Black Hills are essentially flat lying, with some dips ranging from 2 to 5 degrees. Localized structural features also occur in the area. In the proposed mine area the underlying strata dip about one degree to the northeast. A sag area, or "structural low" also occurs within the proposed mine area. This area, which trends towards the northeast, has displacements that are generally less than 100 feet in vertical extent.

Coal beds occur in all members of the Fort Union Formation as well as in the underlying Hell Creek Formation and overlying Wasatch Formation. Only the Tongue River member of the Fort Union, however, contains economically significant coal deposits.

Within the Crow lease, Tracts II and III, four coal seams occur that can be mined by surface methods: The Stray 1, the Rosebud-McKay, the Stray 2, and the Robinson (figure 3). The Rosebud-McKay and Robinson coal seams average 32 feet and 20 feet in thickness respectively while the Stray 1 and Stray 2 seams average about 3 feet in thickness. The Rosebud-McKay is the principal economic coal seam in the area, however this seam has burned in many places including

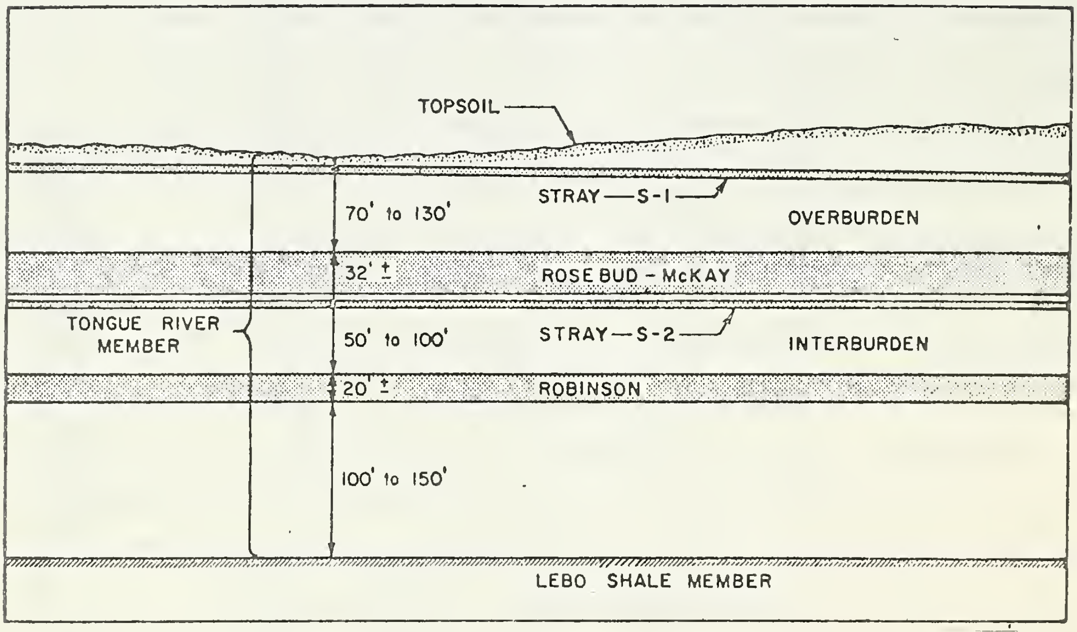

Figure 3. - Geologic cross section of lower strata in the Fort Union Formation (U.S. Bureau of Indian Affairs, 1976)

about half of that which originally underlay the proposed mine area. Red clinker beds are found where such burning occured. The Stray 1 seam is not feasible to mine in most areas as it has high water content, is low in BTU value and pitches erratically. It is also high in sulfur and ash.

The area included within Westmoreland's proposed mine area, (Section 36, T.1N., R.37E.), contains approximately 32 million tons of subbituminous and lignite coal where both the Rosebud-McKay and Robinson seams occur and approximately 12 million tons where only the Robinson seam occurs (personal communication, Nick Tudor, Westmoreland Resources). Totals for the entire mine are on page 7. Figure 2 shows where the burn-line occurs within the proposed mine area. The average analysis of the Westmoreland coal as shipped is given in table 4.

2. Topography

Crow lease tracts II and III lie in the maturely disected Missouri Plateau portion of the Northern Great Plains. Maximum relief in the two lease areas is about 700 feet. Sarpy Creek, the main drainage in Tracts II and III, joins the Yellowstone River at a point approximately 30 miles north of the Absaloka mine area.

The proposal area (Section 36, T.1N., R.37E.,) lies between the middle and East Forks of Sarpy Creek and is located directly south of and adjoining the present Absaloka mine site (figure 2). The Middle Fork of Sarpy Creek flows intermittently as does its tributary that flows in a southwesterly direction through the proposed mine area. Maximum relief

Table 4. -- Physical and chemical analysis of Westmoreland Coal on an as received basis

Proximate Analysis

Component	% by Weight
Moisture	25
Volatile matter	29
Fixed carbon	37
Ash	9
	100

Ultimate Analysis

Component	% by Weight
Carbon, C	50.18
Hydrogen, H_2	3.65
Sulfur, S	.73
Oxygen, O_2	10.58
Nitrogen, N_2	.66
Moisture, H_2O	25.11
Ash	9.09

Btu/lb	8,450
Equilibrium moisture	23.
Grindability index (Hardgrove)	56.

The average analysis of coal shipped as of August 31, 1975 was:

Heat Value: 8,588 Btu/lb
Moisture : 24 Percent
Ash : 10 Percent
Sulfur : 0.72 Percent

within the proposed mine area is approximately 180 feet - from 3,620 feet in the northwest corner of Section 35 to 3,440 feet in the valley of the Middle Fork tributary.

In contrast to Sarpy Creek, which has a flood plain that is nearly a mile wide in places, the Middle Fork and its tributary flow through narrow flood plains. Within Section 36, the valley of the Middle Fork tributary is no more than 200 feet wide in some areas.

3. Climate

The climate of the Sarpy Creek area is semi-arid, with temperature extremes ranging from -50°F in the winter to in excess of 100°F in the summer. Semi-arid regions are those in which rainfall is adequate for short season crops and in which grass is a major component of the ecosystems. Thornwaite (1948) quantified the term through use of the moisture index concept which relates precipitation on a month-by-month basis to maximum evaporation and transpiration. Where precipitation is just adequate to supply the evapotranspiration needs of plants, the moisture index is zero. Climates with an index of zero to -20° are subhumid, between -20° and -40° are semiarid and those below -40° are arid.

A further indication of the dry air condition of southeastern Montana is the fact that up to 80% of the winter snow pack is lost by sublimation. High winds are common in winter and accompany cold waves which are generally of short duration.

Long-term meteorological data for the Sarpy Creek area are nonexistent and are best approximated by records kept at Colstrip, Montana, located 15 miles east-northeast of the Absaloka mine. Climatic data for Colstrip from 1941-1970 are presented in table 5.

Table 5. -- Climatic Summary for Colstrip, Montana

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE
IN COOPERATION WITH COOPERATIVE EXTENSION SERVICE

CLIMATOGRAPHY OF THE UNITED STATES NO. 20 - 24

LATITUDE 45° 53'N
LONGITUDE 106° 36'W
ELEV. (GROUND) 3,221 ft.

CLIMATOLOGICAL SUMMARY

STATION COLSTRIP, MONTANA

MEANS AND EXTREMES FOR PERIOD 1941-1970

Month	Temperature (°F)							Mean degree days **	Precipitation Totals (Inches)									Mean number of days					Month
	Means			Extremes								Snow, Ice Pellets						Temperatures Max.		Min.		
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year		Mean	Greatest daily	Year	Mean	Maximum monthly	Year	Greatest daily	Year	Precip. .10 inch or more	90° and above	32° and below	32° and below	0° and below	
(a)	30	30	30	30		30		20	30	30		30	30		18							
JAN.	34.2	7.7	21.0	67	1953	-40	1954	1356	.56	.62	1943	5.8	11.7	1963	5.5	1946	2	0	11	30	10	JAN.
FEB.	39.8	13.9	26.9	70	1958	-31	1965	1053	.56	.55	1965	5.8	13.3	1955	6.0	1959	2	0	7	27	6	FEB.
MAR.	45.8	18.9	32.3	80	1943	-28	1945	1001	.74	.95	1943	6.0	15.5	1942	5.0	1954	2	0	5	28	3	MAR.
APR.	59.3	30.1	44.7	87	1962+	3	1947+	624	1.86	2.82	1969	5.1	19.0	1955	8.0	1963	5	0	*	19	0	APR.
MAY	69.2	39.4	54.3	96	1948	13	1954	319	2.47	2.15	1946	*	3.0	1953	2.0	1954	6	1	0	5	0	MAY
JUNE	77.6	47.7	62.7	102	1961	28	1964	105	3.31	3.77	1944	*	8.0	1951	8.0	1951	7	3	0	*	0	JUNE
JULY	89.2	53.8	71.5	107	1960	34	1961	12	1.18	1.33	1962+	0	0	----	0	----	3	17	0	0	0	JULY
AUG.	88.1	52.1	70.1	111	1961	33	1966	24	1.39	1.83	1964	0	0	----	0	----	3	15	0	0	0	AUG.
SEP.	75.9	42.0	59.0	102	1960+	18	1942	203	1.38	1.88	1945	*	7.0	1950	7.0	1950	3	4	0	4	0	SEP.
OCT.	64.8	32.4	48.6	94	1963	7	1941	500	1.04	2.07	1958	2.0	13.1	1946	8.0	1946	3	*	*	15	0	OCT.
NOV.	47.5	21.1	34.3	79	1965	-32	1959	915	.67	1.18	1957	3.1	14.0	1941	8.0	1957	3	0	3	26	2	NOV.
DEC.	38.2	12.8	25.5	71	1957	-35	1964	1202	.63	.58	1958	6.8	15.6	1964	9.5	1958	2	0	9	30	6	DEC.
Year	60.8	31.0	45.9	111	AUG. 1961	-40	JAN. 1954	7314	15.79	3.77	JUNE 1944	34.6	19.0	APR. 1955	9.5	DEC. 1958	41	40	35	184	27	Year

(a) Average length of record, years.

T Trace, an amount too small to measure.

** Base 65°F

+ Also on earlier dates, months, or years.

* Less than one half.

Greatest daily snow for period 1946-1963

In February, 1975, climatic data-gathering equipment was installed near the coal crushing and storage facilities at the Absaloka mine site. Additional meteorological equipment was installed near the mine's administration building in April, 1975. Precipitation, temperature and relative humidity data from these sites are presented in tables 6, 7 and 8. A wind rose for the Sarpy Creek area is presented in figure 4.

For most of eastern Montana, the annual mean total precipitation level is 12-16 inches, with May, June, and July being the wettest months. At Colstrip, the official mean precipitation level for 1936-1975 was 15.79 inches. The period from 1967-1975, however, experienced unusually consistent above average precipitation (Montana Dept. of State Lands, 1976a). Droughts in the Northern Great Plains have been observed to occur with a frequency that appears to be in 11 and 23 year cycles (Toole, 1976). Related discussion is presented in the final EIS for the proposed expansion of Western Energy Co.'s Rosebud Mine in Area B (Montana Dept. of State Lands, 1976a).

4. Air quality

Sources of dust emissions in the Sarpy Creek area include dust from the Absaloka mine site and coal processing facilities, unimproved or scoria surfaced roads, cultivated fields, barren slopes, and overgrazed sites. Fugitive dust and dust emissions have increased significantly at the proximity of the mine since the mine's opening in 1974.

Table 6. -- Total precipitation (mm)[a], Sarpy Creek area
(April 19, 1975 - April 18, 1976)
(Westmoreland Resources, 1976c)

Day of	1975									1976			
Month	A	M	J	J	A	S	O	N	D	J	F	M	A
1		3	0	0	0	0	0	0	0	3	0	2	0
2		0	0	0	0	4	0	0	0	0	0	0	4
3		0	0	0	0	0	0	0	0	0	0	0	0
4		0	0	1	0	0	0	0	0	0	1	0	0
5		8	0	1	0	0	0	0	1	2	0	0	0
6		27	1	0	0	0	0	0	0	0	0	0	0
7		1	0	0	0	0	0	0	0	3	0	0	0
8		1	26	0	0	0	0	0	0	0	0	0	0
9		1	1	0	0	0	0	0	0	0	0	0	0
10		4	0	0	0	0	0	3	7	0	0	1	0
11		0	0	0	0	0	0	0	2	0	0	2	0
12		0	0	0	0	0	1	0	3	0	4	0	0
13		0	1	0	0	0	1	0	1	0	0	0	7
14		0	0	0	1	0	6	0	0	0	1	0	11
15		0	0	0	7	0	0	0	9	2	0	0	3
16		3	2	0	0	0	0	2	0	0	0	0	10
17		0	0	9	4	5	0	2	0	0	0	0	0
18		0	5	0	0	0	0	6	0	1	0	0	0
19	1	17	2	0	0	0	0	0	0	0	0	0	
20	1	4	1	0	0	0	4	0	0	0	0	3	
21	1	2	14	0	0	0	12	0	0	0	0	0	
22	2	2	0	1	0	0	5	0	0	0	0	0	
23	5	9	0	0	0	0	0	1	0	0	0	0	
24	0	5	0	0	0	0	0	15	0	0	0	1	
25	1	2	0	0	1	0	0	3	0	0	0	3	
26	5	0	3	0	0	0	0	1	0	1	2	0	
27	0	0	0	0	0	0	0	1	0	0	6	0	
28	10	0	0	0	0	0	0	3	0	0	4	0	
29	15	0	0	1	0	0	0	1	0	0	1	0	
30	5	0	0	0	0	0	0	1	1	0	0	0	
31	0	9	0	10	0	0	0	0	3	0	0	0	
Total		84	57	30	13	9	27	41	28	13	10	12	

The total precipitation (mm) is: 410mm
16.14 in.

[a] In the conversion from inches to millimeters, daily precipitation totals that were less than .04 inch are not reflected in daily figures of the table but are accounted for in the monthly and annual totals.

Table 7. -- Mean and extreme monthly and annual temperatures, Sarpy Creek area, (April 19, 1975-April 18, 1976) (Westmoreland Resources, 1976c)

Month	Average Daily Maximum	Average Daily Minimum	Daily Average	Monthly Maximum	Monthly Minimum
JAN	.1	-8.5	-4.0	9.5	-26.5
FEB	4.3	-4.2	- .0	14.0	-21.0
MAR	5.3	-4.6	.3	18.0	-21.0
APR	13.5	3.5	8.4	24.5	- 5.0
MAY	15.1	5.7	10.4	28.8	- .5
JUN	19.2	10.1	14.7	24.0	5.0
JUL	28.0	17.4	22.7	36.0	12.0
AUG	25.9	14.2	20.1	33.0	8.5
SEP	20.6	9.3	15.2	29.0	1.0
OCT	12.4	3.9	8.4	28.0	- 4.0
NOV	4.4	-3.7	.5	24.0	-22.0
DEC	2.8	-5.0	-1.3	20.0	-18.5
ANN	12.3	2.8	7.6	36.0	-26.5

Table 8. -- Mean and extreme monthly and annual relative humidity (%) Sarpy Creek area (April 19, 1975-April 18, 1976)

(Westmoreland Resources, 1976c)

Month	Average Daily Maximum	Average Daily Minimum	Daily Average	Monthly Maximum	Monthly Minimum
JAN	92	51	67	96	31
FEB	89	42	63	96	16
MAR	92	34	58	97	14
APR	94	31	58	97	8
MAY	92	31	59	97	8
JUN	89	28	54	97	9
JUL	88	25	51	95	11
AUG	85	26	48	96	7
SEP	85	25	48	96	9
OCT	90	41	63	95	12
NOV	92	39	61	95	12
DEC	92	58	73	96	38
ANN	90	35	58	97	7

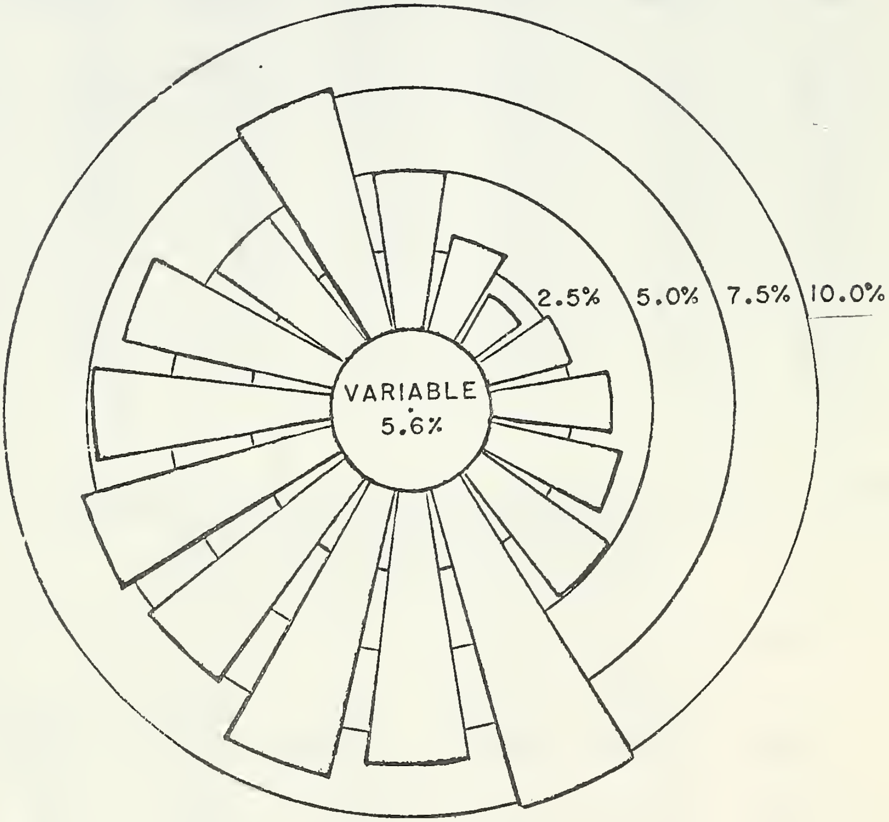

Figure 4. - Annual percent frequency of surface wind direction, Sarpy Creek area - April 19, 1975 to April 18, 1976. (Westmoreland Resources, 1976c)

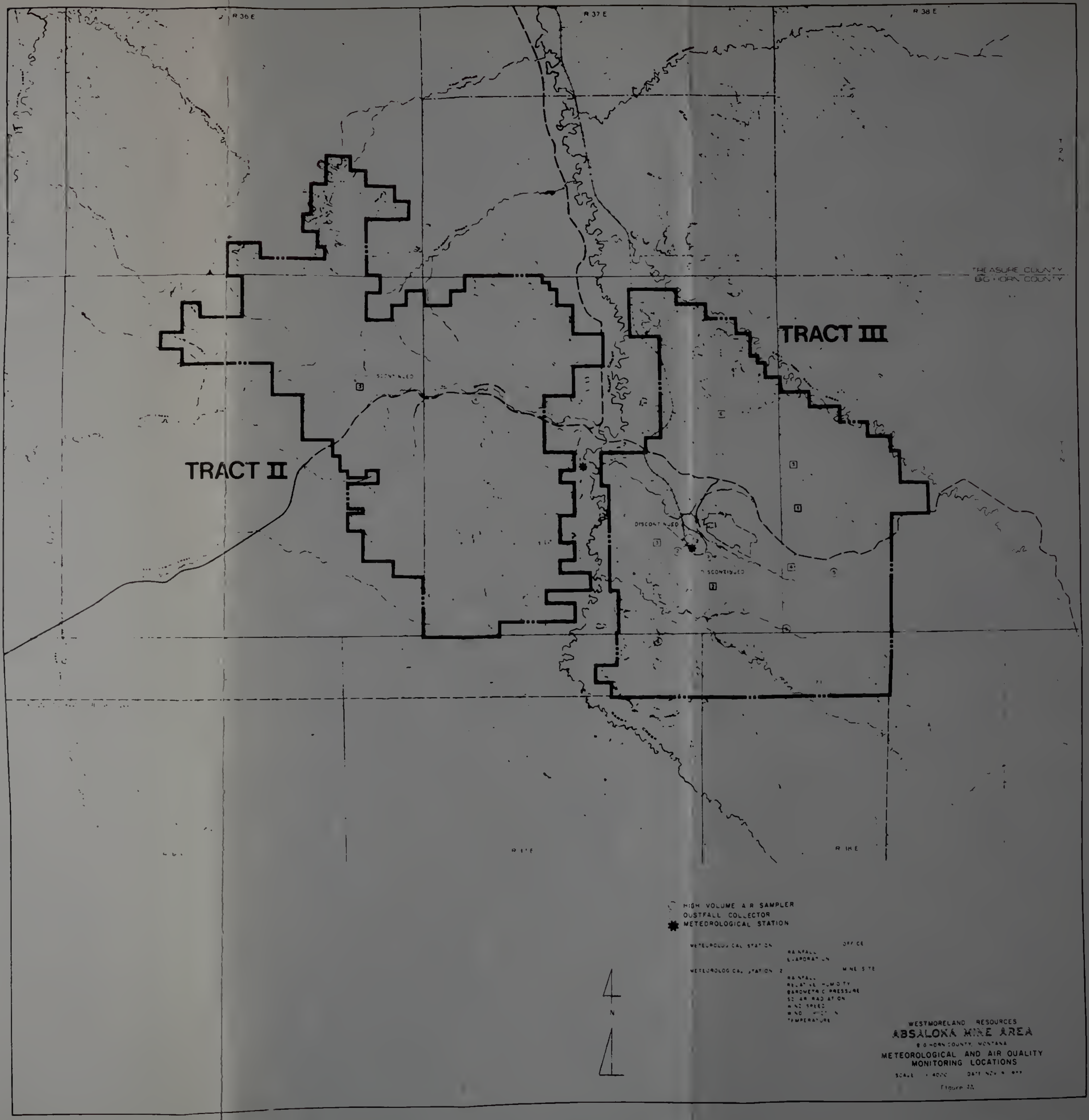R 36 E
R 37 E
R 38 E
T 2 N
T 1 N
TREASURE COUNTY
BIG HORN COUNTY
TRACT II
TRACT III
DISCONTINUED
DISCONTINUED
DISCONTINUED
N
HIGH VOLUME AIR SAMPLER
DUSTFALL COLLECTOR
METEOROLOGICAL STATION
METEOROLOGICAL STATION
OFFICE
RAINFALL
EVAPORATION
METEOROLOGICAL STATION 2
MINE SITE
RAINFALL
RELATIVE HUMIDITY
BAROMETRIC PRESSURE
SOLAR RADIATION
WIND SPEED
WIND DIRECTION
TEMPERATURE
WESTMORELAND RESOURCES
ABSALOKA MINE AREA
BIG HORN COUNTY, MONTANA
METEOROLOGICAL AND AIR QUALITY
MONITORING LOCATIONS
SCALE
DATE NOV

Figure 4A

Montana ambient air-quality standards relevant to air quality studies in the Sarpy Creek area are listed in table 9. National ambient air quality standards are listed in table 10.

a. Total suspended particulates

Total suspended particulate (TSP) data for the Sarpy Creek area are available for the period from February, 1975, to August, 1975, and are presented in table 11. TSP levels were measured at the following sites within the tract III area:[1]

Station no. 1 - A high volume air sampler was located on the roof of the mine's water treatment building in February, 1975, and removed in April, 1975.

Station no. 2 - Beginning in April, 1975, a high volume air sampler was located on a small rise of ground approximately 100 feet south of the roof of the water treatment building (near the mine's weather station).

Station no. 3 - Beginning in April, 1975, a high volume air sampler was located about 300 feet east-northeast of the mine's secondary crusher. After several months, this sampler was relocated to another site (station no. 4) on lease tract II in order to obtain background TSP information.

Federal and state TSP standards are calculated on an annual basis (tables 9 and 10). On the basis of the data available, station 1 and 3 would appear to have measured TSP levels below the maximum annual geometric averages standards (federal and state). Station no. 3 however, reported a geometric mean of 106 which, if maintained on an annual basis, would

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[1] See figure 4A for site locations.

Table 9. -- Selected Montana ambient air-quality standards (Montana Department of Health and Environmental Sciences, 1967)

Pollutants	Standards
Particulates	
Total suspended	75 ug/m^3 - annual geometric mean 200 ug/m^3 - not to be exceeded more than 1% of days/year.
Settled (dustfall)	15T/mi^2/mon - 3-month average residential 30T/mi^2/mon - 3-month average industrial
Sulfur oxides	
Sulfur dioxide	0.02 ppm - maximum annual average 0.10 ppm - 24-hour average not to be exceeded over 1% of days/3 months 0.25 ppm - not to be exceeded more than 1 hour/4 consecutive days
Suspended sulfate	4 ug/m^3 - maximum annual average 12 ug/m^3 - not to be exceeded over 1% of time
Reactive sulfur (sulfation)	0.25 mg SO_3/100cm^2/day - maximum annual average 0.50 mg SO_3/100cm^2/day - maximum for any 1-month period

ug/m^3 = micrograms per cubic meter of air
T/mi^2/mon = tons per square mile per month
ppm = parts per million

Table 10. -- National ambient air-quality standards (U.S. Environmental Protection Agency, 1971)

	Pollutant	Primary standard[1]	Secondary standard[2]
1.	Sulfur oxides	80 ug/m^3 (0.03 ppm) annual arith. mean 365 ug/m^3 (0.14 ppm) max 24 hr conc. not to be exceeded more than once a year.	1,300 ug/m^3 (0.5 ppm) max 3 hr conc. not to be exceeded more than once a year.
2.	Particulate	75 ug/m^3 annual geom. mean 260 ug/m^3 max 24 hr conc. not to be exceeded more than once a year.	60 ug/m^3 annual geom. mean[3], 150 ug/m^3 max 24 hr conc. not to be exceeded more than once a year.
3.	Carbon monoxide	10,000 ug/m^3 (9 ppm) max 8 hr conc. not to be exceeded more than once a year.	Same as primary.
		40,000 ug/m^3 (35 ppm) max 1 hr conc. not to be exceeded more than once a year.	Same as primary.
4.	Photo chemical oxidants (corrected for NO_2 and SO_2) interference.	100 ug/m^3 (0.08 ppm) max 1 hr conc. not to be exceeded more than once a year.	Same as primary.
5.	Hydrocarbons (corrected for CH_4)	160 ug/m^3 (0.24 ppm) max 3 hr conc. (6 to 8 a.m.) not to be exceeded more than once a year.	Same as primary.
6.	Nitrogen oxides (as nitrogen dioxide)	100 ug/m^3 (0.05 ppm) annual arith. mean.	Same as primary.

[1] Primary air-quality standards were established to protect health.

[2] Secondary air-quality standards were established to protect aesthetic values.

[3] To be used as guide in assessing State implementation plans.

Table 11. -- Total suspended particulates, Sarpy Creek area (Westmoreland Reources, 1976c)

Date (1975)	TSP ($\mu g/m^3$)[a] High-Volume Air Sampler Station #1	TSP ($\mu g/m^3$)[b] High-Volume Air Sampler Station #2	TSP ($\mu g/m^3$)[c] High-Volume Air Sampler Station #3	TSP ($\mu g/m^3$)[d] High-Volume Air Sampler Station #4
2/17-2/18	(-)			
2/18-2/19	6			
2/23-2/24	7			
3/ 1-2/ 2	22			
3/ 7-3/ 8	36			
3/13-3/14	27			
3/19-3/20	74			
3/25-3/26	61			
3/31-4/ 1	(-)			
4/ 6-4/ 7	6			
4/12	(-)			
4/18	(-)			
4/24		18	34	
4/30		3	25	
5/ 6		17	44	
5/12		39	(-)	
5/18		17	47	
5/24		25	38	
5/30		42	235	
6/ 5		40	(-)	
6/11		20	131	
6/17		27	86	
6/23		35	207	
6/29		34	82	
7/ 5		(-)	61	
7/11		76	(-)	
7/17		31	82	
7/23		108	(-)	
7/29		205	1182	
8/ 4		46	323	
8/10		92	178	
8/16		40	94	
8/22		(-)	(-)	
8/28		82	302	

(-)Missing or invalid data.

a located atop water treatment building
b located 100 feet south of water treatment building (with meteological station)
c located North and East of crusher
d located in Tract II

exceed the federal primary and secondary standard and the Montana standard for annual geometric mean TSP levels.[1] Furthermore, on five occasions in 1975, the 24-hour TSP concentrations at Station 3 exceeded 200 ug/m^3. This violates the Montana air-quality standards which permit a TSP level of 200 ug/m^3 to be exceeded no more than one percent of the days per year.

Background TSP levels for the Sarpy Creek area can be approximated from data collected at nine TSP monitoring stations operated by the Montana Department of Health and Environmental Sciences in relatively undisturbed areas in eastern Montana. The 1976 range in geometric mean for these stations was from 15.7 to 31.8 ug/m^3 (U.S. Geological Survey, Montana Dept. of State Lands, 1976).

b. Settleable particulates

Settleable particulate data for the Sarpy Creek area are available from April, 1975, to April, 1976, and are given in table 12. Dustfall canisters were installed at two locations in lease Tract III about 3/4 mile to the northeast of the mine site (station no. 1) and about 3/4 mile to the south of the mine site (station no. 2). A third canister (station no. 3) was installed approximately 5 miles west-northwest of the mine site for the purpose of obtaining data on background levels (U.S. Bureau of Indian Affairs, 1976).

The Montana air quality standard for settleable dust in heavy industrial areas is a three-month average of 30 tons/mile/month. This standard was exceeded at all three sites during the above mentioned time span.

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[1] Station #3 was located near an unpaved road and the crushing and hauling facilities.

Table 12. -- Settleable particulates (dustfall), Sarpy Creek area
April 24, 1975 to April 19, 1976
(Westmoreland Resources, 1976c)

Data Collection Period	Settleable Particulates[a] (tons/mile^2/month)		
	Sampling Station #1	Sampling Station #2	Sampling Station #3
4/24/75- 5/23/75	4.157	3.734	(-)
5/23/75- 6/20/75	7.609	8.157	(-)
6/20/75- 7/21/75	4.691	20.500[b]	17.884
7/21/75- 8/19/75	26.135	40.222	120.699
8/19/75- 9/18/75	70.153	90.547	85.527
9/18/75-10/17/75	2.949	8.126	16.048
10/17/75-11/21/75	30.307	157.542	96.163
11/21/75-12/24/75	12.942	7.906	17.946
12/24/75- 1/23/76	15.937	10.447	8.956
1/23/76- 2/19/76	28.817	28.237	2.353
2/19/76- 3/26/76	17.027	14.401	18.157
3/26/76- 4/19/76	65.82	(-)	(-)
Highest three-month Average (data period)	37.22 (1/23/76- 4/19/76)	85.41 (8/19/75- 11/21/75)	74.70 (6/20/75- 9/18/75)

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[a] Much of the settleable particulates measured during the first four data collection periods was attributable to the presence of algae in the samples.

[b] Estimate

5. Soils

Ten basic soil mapping units, including eight series and two soil complexes, are found in the proposed mine area (Westmoreland Resources, 1976b). Soil thicknesses are quite variable, with depth to the base of C-horizon ranging from about 18" (Wibaux series) to over 60" (Spearman, Ft. Collins, Chugter and Alice series). A soils map of the proposed mine area is presented in figure 5. The various soil surveys are described in the federal environmental impact statements.

A variety of soil forming processes are represented within the proposed mine area. Soils have formed directly from sandstone and shales of the Ft. Union Formation, (both metamorphosed and unmetamorphosed), from pre-existing loams, and from alluvial valley fill or fan deposits. Texturally, A- and C-horizons of the units are loams, frequently gravelly or sandy. As is typical of soils of the Northern Great Plains, B-horizons are commonly absent. Where they do occur (Alice, Custer, Cushman, Nelson, Ft. Collins and Spearman Series), the B-horizons are texturally heavier than the A- and C-horizons, with clay contents being diagnostic.

Thickness of clay-rich horizons vary considerably, with the thickest units being the B-horizons of the Ft. Collins and Chugter loams, which range up to 23" in thickness. In places, however, these two series have B-horizons no more than 7-8" in thickness.

Soil series do not directly correlate with topography. The greatest concentrations of Ft. Collins and Thedalund (8-25% slopes) are, however, in drainageways, even though the two series are quite different in description. The other series tend to occur on ridges, knolls, and slopes.

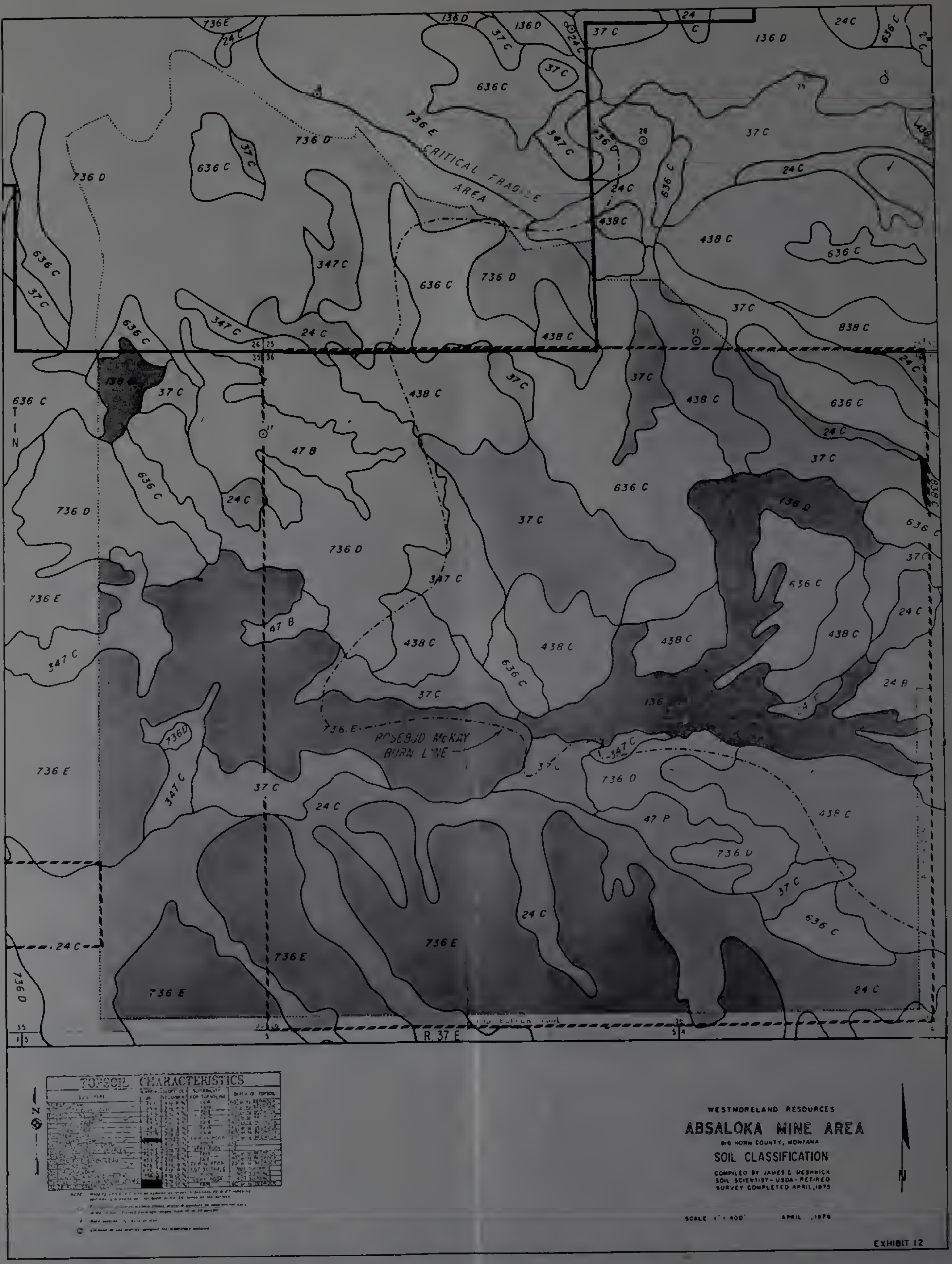


Figure 5.-- Soils map for Section 36, T.1N. R.37E. (Westmoreland Resources, 1976b)

Analyses taken from the original survey of Tract III are presented in Appendix B. In addition, a few chemical analyses were performed on soil samples taken from the proposed permit area. These data indicate that most soil profiles in Section 36 are characterized by low SAR's and conductivities. A few samples of Chugter and Thedalund-Wibaux soils have high conductivities in the C-horizon; up to 13.3 mmhos/cm for the Chugter loams outside section 36.

Carbonate minerals are commonly present as threads, film, or mottles. Some of the carbonate may be remnants of a calcareous sandstone or shale from which the soil profile formed in place.

6. Hydrology

The two major drainages of Tracts II and III are Tullock Creek to the west of Tract II and Sarpy Creek which separates the two tracts. The total drainage area of Sarpy Creek, including the East Fork, is 453 square miles. Six square miles of Tracts II and III drain toward Sarpy Creek, while two square miles of Tract III drain toward East Fork Sarpy Creek. The gradient of Sarpy Creek averages 15 feet per mile.

Streamflow data in Sarpy Creek near Hysham for partial water year 1975 are presented in Table 13. These data are preliminary, as the U.S. Geological Survey has only recently begun monitoring in Sarpy Creek.

Seven staff gauges have been installed in the Tract II and Tract III project area and streamflow data has been accumulated since March, 1975. The slope area method was used to obtain some early estimates of streamflow, as presented in Table 13.

Table 13. -- Discharge measurements, Sarpy Creek near Hysham, Montana and Tullock Creek near Bighorn, Montana, for the 1975 water year[a] (Westmoreland Resources 1975d)

Sarpy Creek Near Hysham, Montana

Date	Discharge (cfs)	Date	Discharge (cfs)
Sept. 23	0.0	Jan. 22	160.0
Oct. 18	0.0	Jan. 24	57.6
Nov. 1	0.0	Feb. 3	5.37
Nov. 6	0.0	Feb. 26	178.0
Dec. 3	0.28	Mar. 3	387.0
Jan. 6	0.58	Apr. 1	15.5
Jan. 19	193.0	June 2	11.4
Jan. 20	392.0	July 9	3.4

Tullock Creek Near Bighorn, Montana

Date	Discharge (cfs)	Date	Discharge (cfs)
Aug. 12	0.0	Jan. 23	203.0
Sept. 12	0.0	Jan. 28	43.9
Oct. 18	0.0	Feb. 26	30.1
Oct. 22	0.0	Mar. 3	1160.0
Nov. 1	1.86	Mar. 4	403.0
Nov. 8	.11	Mar. 17	49.4
Dec. 3	0.49	Apr. 23	28.5
Jan. 6	0.82	May 10	69.1
Jan. 10	672.0	June 11	9.54
Jan. 19	527.0	July 14	12.6

---

[a] Provisional data subject to change provided by U.S. Geological Survey, Water Resources Division Office, Billings, Montana.

The formula involved is $Q = K S$

where Q = streamflow
S = slope of water surface
K = average conveyance

$$K = \frac{1.49}{N} AR^{2/3}$$

when N = Manning's coefficient
A = cross-sectional area of channel
R = hydraulic radius of channel

a. Surface water - water quality

Water analyses from the Sarpy Creek area are presented in appendix C.

Waters of Sarpy Creek and East Fork Sarpy Creek are magnesium and calcium sulfate with pH values ranging from 7.9 to 8.4 total dissolved solid (TDS) concentrations and dissolved salt concentrations vary with time of year, the lowest values occurring during snowmelt runoff and the highest during times of low flow. Average values of 3000 mg/l TDS occur in the drainages of Sarpy and East Fork Sarpy Creek during the latter period. Calcium, magnesium and bicarbonate concentrations appear to be near the saturation point during times of low flow.

b. Groundwater hydrology

Within the Tract II and Tract III project area, deep and shallow aquifer systems exist separated by a thick shale sequence of the Montana Group which prevents movement of waters between the two. The deep Paleozoic aquifer system is not used as a water source near the project area except for one well drilled in the Madison forewaters.

Productive units of the shallow aquifer system include Quaternary alluvium and siltstone, sandstone, and coal of the Fort Union Formation. Recharge to groundwater systems in the Tract III area is largely from the Little Wolf Mountains located to the southeast. Numerous springs occur in Tracts II and III as shown in figure 6, including 2 in Section 36 which recharge to the Middle Fork of the Sarpy Creek tributary that bisects the proposed mine area (figures 2 and 7).

The spring designated as 237 (figure 6) in the Dames and Moore Spring inventory (Westmoreland Resources, 1975d) receives water from the saturated overburden. Appendix I (potentiometric map of overburden) clearly shows that the outcrop of the overburden and the potentiometric surface of groundwater in the overburden corresponds to the location of spring 237 and a seep up the coulee from spring 238. Spring 238, although flowing out of alluvium, ultimately receives overburden water from the seep up the coulee. The seep was developed at one time and provided domestic water for the Roberts homestead. Both springs have relatively high quality when compared to other water sources in the Tract III area (see memorandum from Mike Bishop in Appendix C). These two springs contribute water to the valley fill in the coulee bottom which may also receive water from stratigraphically lower saturated zones that subcrop to the coulee. Seeps have been identified along the coulee where impermeable zones beneath the valley fill allow the groundwater to approach the ground surface. Subirrigated conditions such as these can withstand greater grazing pressure through the summer months and provide vegetation that is higher in protein and is more digestible than cured grasses on drier slopes.

There is structural evidence, shown on figure 7 and Appendix J, suggesting that a displacement may have taken place within Section 36. The structural trough running northeast-southwest through the section serves as a ground water storage basin, which can be seen by observing increasing depths of saturation across the trough in appendix I and J. The flow of groundwater along the structural feature is influenced by topography and the storage of ground water in the basin described above. Storage of water in the trough produces mounding of saturated thickness as depicted and therefore, allows the ground water to intersect the ground surface and flow at the locations of the springs. Since the trough extends beneath the topographic divide into the basin of the East Fork of Sarpy Creek it is likely that the storage of groundwater also influences the location of spring 277. If folding or faulting occurred to produce the structural low in Section 36, an associated increase in transmissivity may be present due to the fracturing or jointing of the coal.

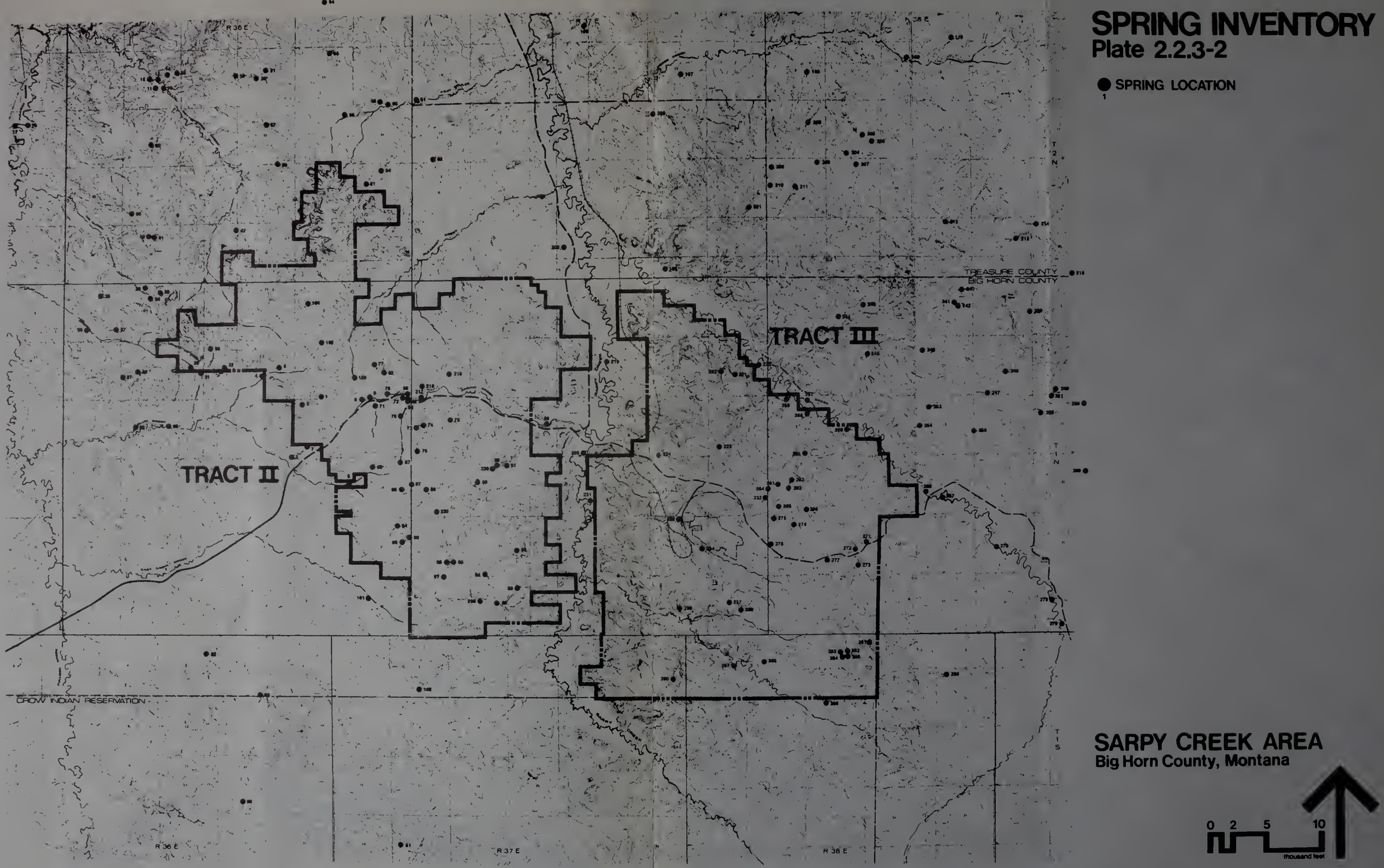


Figure 6.-- Description of environmental spring inventory Tract II and Tract III, Big Horn County, Montana (Westmoreland Resources, 1975d)

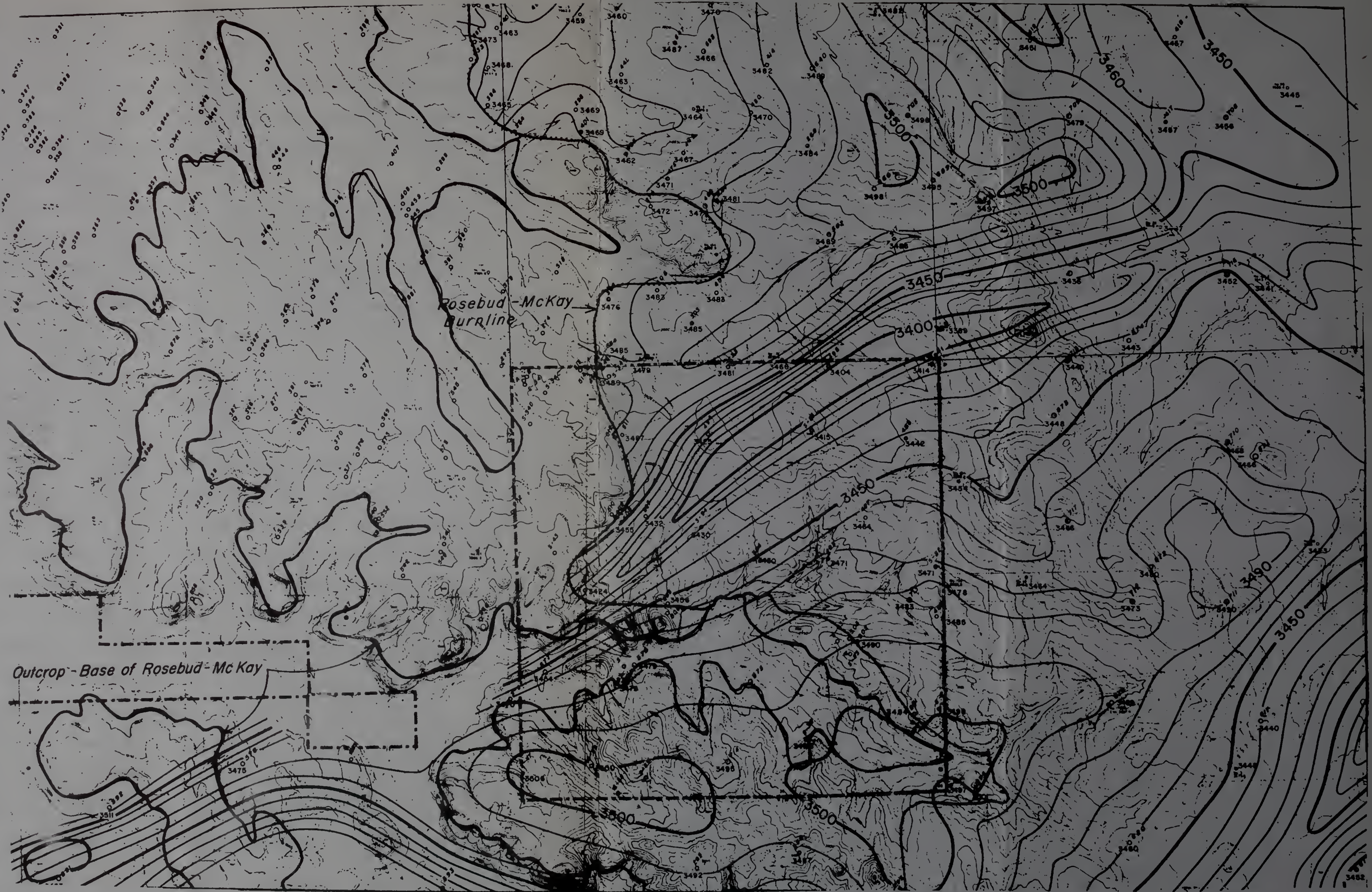


Figure 7.-- Structure map of base of Rosebud-McKay seam
for Section 36, T.1N. R.37E. and adjacent areas
(submitted to DSL by Westmoreland Resources on February 2, 1977)

Several wells occur on Tracts II and III, as shown on figure 8, and most are located in the alluvium or the lower portions of the Fort Union Formation. There are no production wells in the proposed mine area. There are observation wells in the Rosebud-McKay and Robinson coal aquifers and the Sub-Robinson zone in this area.

Discharge tests conducted by Dames & Moore (Westmoreland Resources, 1975d) in some alluvial wells in Tracts II and III gave continuous yields of 5 to 46 gpm for 2-3 hours. Transmissivity values range from 1000 to 12000 gpd/ft. depending on the amounts of silt and sand. In Section 36, alluvium is restricted in occurrence.

Both Rosebud-McKay and Robinson seams occur only in the northeastern half of the project area. In the remainder of the area, the Rosebud-McKay has burned and thick deposits of clinker occur separated from the Stray 2 coal seam by a thin shale horizon. Clinker has moderate to high infiltration rates and serves as a mechanism to recharge contiguous units, particularly the Rosebud-McKay. Sandstones and siltstone of the overburden are weathered to depths of 20-50', especially along the higher elevations. Hydrologic parameters of overburden and other units in Tracts II and III are presented in Table 14.

The Rosebud-McKay coal seam functions as a significant aquifer in the southern part of Tract III as shown in figure 9A. The potentiometric surface is significantly above the base of the coal in the southeastern part of Tract III (including the project area), converging towards and finally intersecting

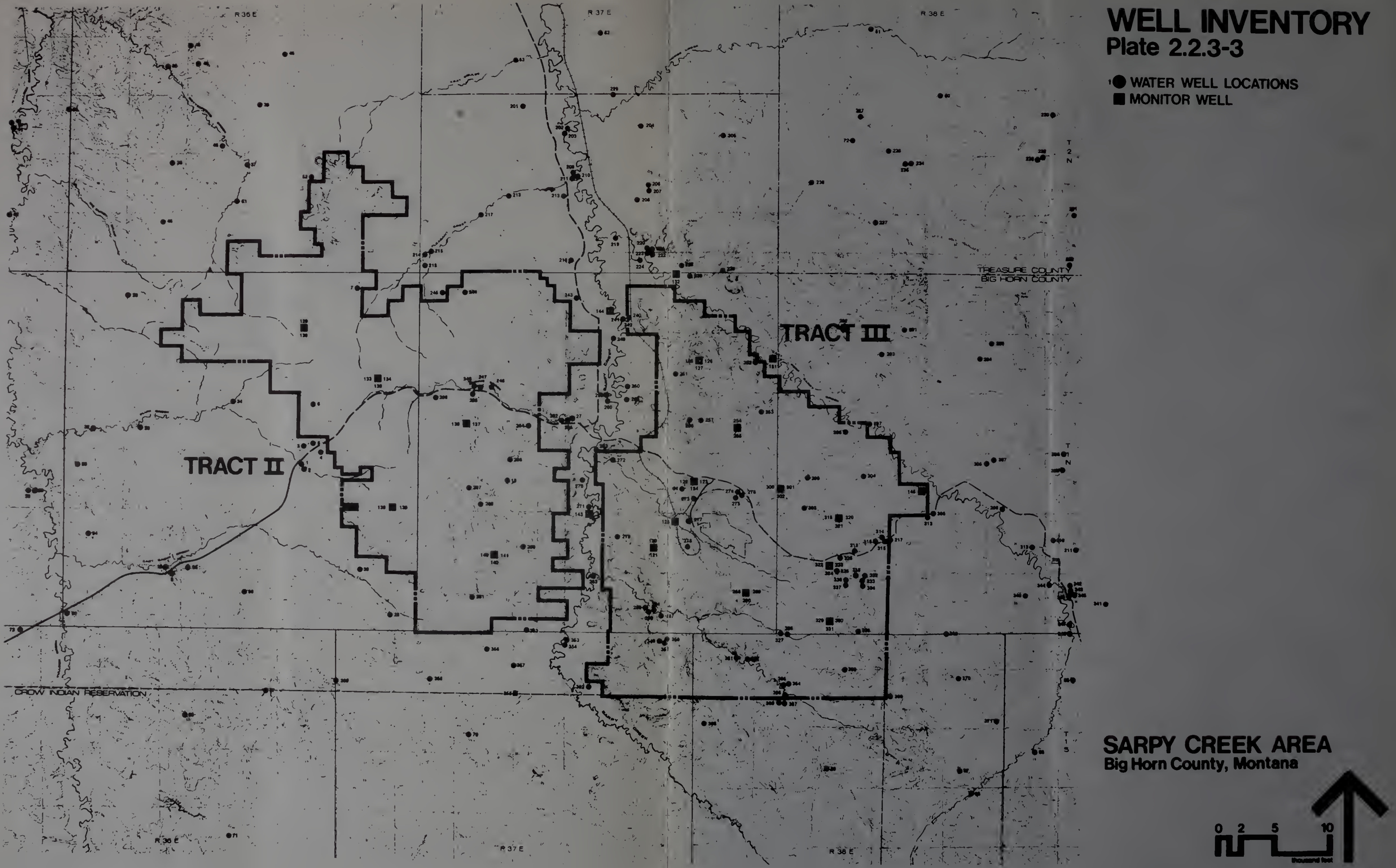


Figure 8.-- Well inventory, Tract II and Tract III, Big Horn County, Montana
(Westmoreland Resources, 1975d)

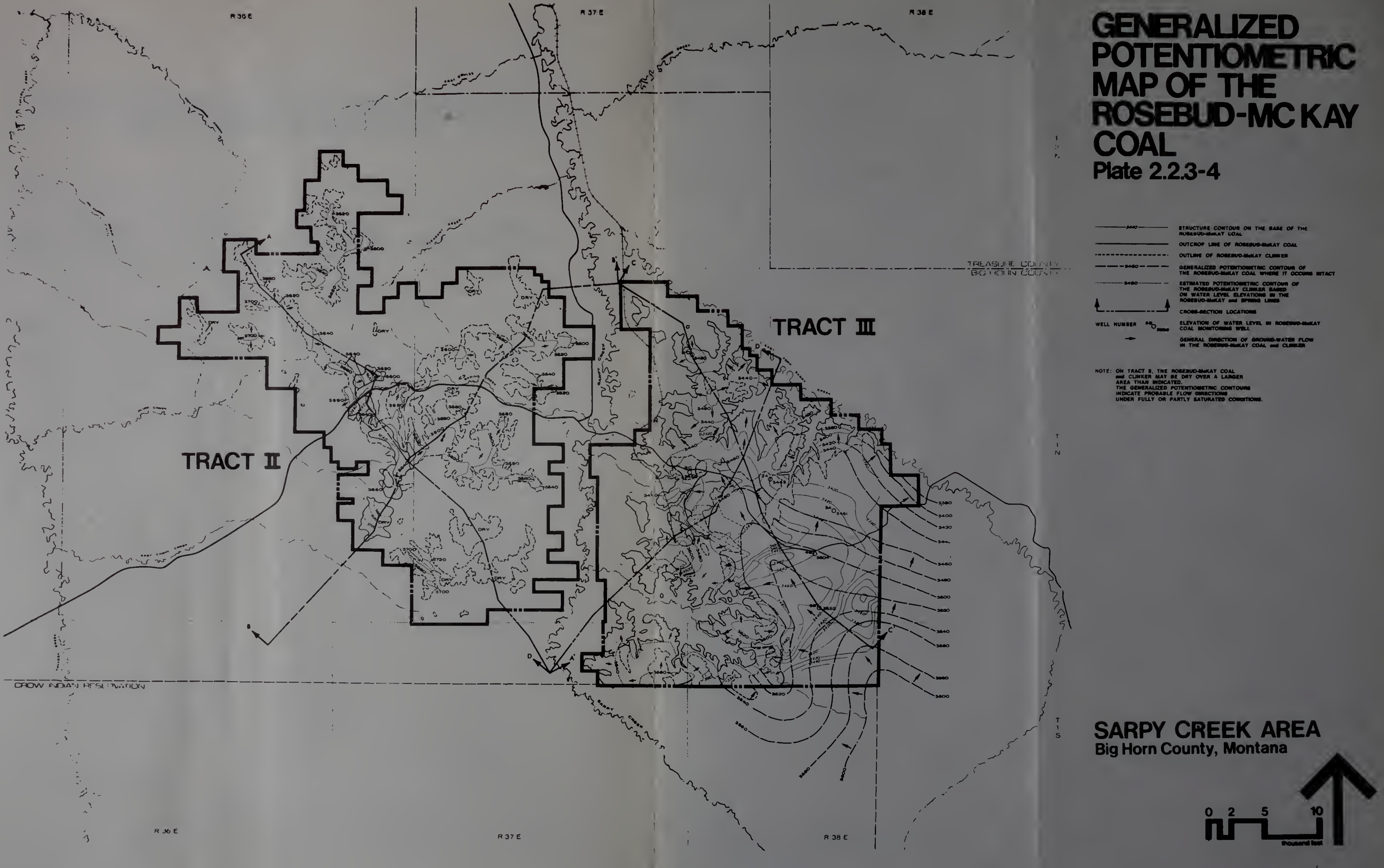

GENERALIZED POTENTIOMETRIC MAP OF THE ROSEBUD-MC KAY COAL
Plate 2.2.3-4
3440 STRUCTURE CONTOUR ON THE BASE OF THE ROSEBUD-McKAY COAL
OUTCROP LINE OF ROSEBUD-McKAY COAL
OUTLINE OF ROSEBUD-McKAY CLINKER
3460 GENERALIZED POTENTIOMETRIC CONTOUR OF THE ROSEBUD-McKAY COAL WHERE IT OCCURS INTACT
3420 ESTIMATED POTENTIOMETRIC CONTOUR OF THE ROSEBUD-McKAY CLINKER BASED ON WATER LEVEL ELEVATIONS IN THE ROSEBUD-McKAY and SPRING LINES
CROSS-SECTION LOCATIONS
WELL NUMBER ELEVATION OF WATER LEVEL IN ROSEBUD-McKAY COAL MONITORING WELL
GENERAL DIRECTION OF GROUND-WATER FLOW IN THE ROSEBUD-McKAY COAL and CLINKER
NOTE: ON TRACT II, THE ROSEBUD-McKAY COAL and CLINKER MAY BE DRY OVER A LARGER AREA THAN INDICATED. THE GENERALIZED POTENTIOMETRIC CONTOURS INDICATE PROBABLE FLOW DIRECTIONS UNDER FULLY OR PARTLY SATURATED CONDITIONS.
TRACT II
TRACT III
R 36 E
R 37 E
R 38 E
T 1 N
T 1 S
TREASURE COUNTY
BIG HORN COUNTY
CROW INDIAN RESERVATION
SARPY CREEK
DRY
SARPY CREEK AREA
Big Horn County, Montana
0 2 5 10
thousand feet

Figure 9A.--Generalized potentiometric map of the Rosebud-McKay coal (Westmoreland Resources, 1975d)

Table 14. -- Transmissivity$^{(T)}$ and permeability$^{(K)}$ of geologic units tapped by observation wells in the Sarpy Creek Project Area (Westmoreland Resources 1975d)

AQUIFER NAME-WELL NUMBER	GRAVEL INTERVAL (feet) FROM	GRAVEL INTERVAL (feet) TO	TESTED THICKNESS (feet)	PUMPING T (gpd/ft)	PUMPING K (cm/sec)	PUMPING LENGTH OF TEST (min.)	RECOVERY T (gpd/ft)	RECOVERY K (cm/sec)	RECOVERY LENGTH OF TEST (min.)	FALLING HEAD T (gpd/ft)	FALLING HEAD K (cm/sec)	FALLING HEAD LENGTH OF TEST (min.)
ALLUVIUM - 10	2	20	18			.75	1.1[a]	2.9×10^{-6}	13			
18	3	50	47	5280	3.3×10^{-5}	15	6815 11755	6.8×10^{-3} 1.2×10^{-2}	15			
19	3	40	37			15	1005 2640	1.3×10^{-3} 3.4×10^{-3}	13			
20	3	80	77			15	6212	3.8×10^{-5}	15			
ROSEBUD-McKAY OVERBURDEN												
4A	55	61	6			8	17	1.3×10^{-6}	15			
5A	46	63	17	634[b]	1.8×10^{-5}	180[b]	587	1.6×10^{-3}	31	725	2.0×10^{-3}	16
ROSEBUD-McKAY COAL												
2A	15	45	30	16	2.2×10^{-5}	25	11	3.5×10^{-5}	60			
3A	112	142	30				4.6	7.2×10^{-6}	13			
4B	70	111	41	5	5.8×10^{-6}	130	9	1.0×10^{-3}	40	6.07	4.7×10^{-6}	55
5B	91	133	64	35[b]	3.8×10^{-5}	60[b]	3.1[a]	3.5×10^{-6}	17	44.5	4.8×10^{-5}	45
6A	70	110	40	1[b]	1.2×10^{-6}	60	3.5[a]	4.1×10^{-6}	20	5.5	3.9×10^{-6}	45
8	68	100	32			27	1.8[a]	2.7×10^{-6}	17	7.5 9.4	1.1×10^{-5} 1.4×10^{-5}	55
INTERBURDEN												
14B	131	170	39	7.3	8.8×10^{-6}	60	8	9.7×10^{-6}	60	18 36	5.4×10^{-5} 4.4×10^{-5}	60
ROBINSON COAL 1A	48	72	24	16	2.8×10^{-5}	120	21	6.1×10^{-3}	60			
2B	105	125	20	2.9[b]	6.8×10^{-6}	120[b]	2.3[a]	5.4×10^{-6}	20	3.9	9.2×10^{-6}	30
3B	195	215	20			15	2.6[a]	3.3×10^{-6}	13			
4C	165	211	47			60	2.4 12.5	2.6×10^{-6} 1.3×10^{-5}	485	27.6	1.8×10^{-3}	60
5C	247	267	20	5[b]	7.1×10^{-6}	120[b]	6.7[a]	1.1×10^{-3}	35	2.2	5.2×10^{-6}	60
6B	175	196	21	13[b] 21	2.9×10^{-5} 4.7×10^{-3}	110[b] 120	8	1.8×10^{-3}	60	12	2.7×10^{-5}	60
8B	141	163	44			13	2.8[a]	3.0×10^{-6}	13	1.6	1.7×10^{-6}	75
15B	70	97	27			15	3.1[a]	3.4×10^{-6}	15			
16B	65	100	35			13	1.7[a]	2.3×10^{-6}	16	1.8	2.4×10^{-6}	46
SUB-ROBINSON												
1B	65	125	60	87	1.0×10^{-4}	120	56	6.6×10^{-3}	289			
2C	172	231	60	469 504	5.7×10^{-4} 4.0×10^{-4}	150[b] 690	131 653[b]	1.0×10^{-4} 5.0×10^{-4}	30 60[b]	67 324	7.5×10^{-5} 3.8×10^{-4}	10
3C	150	190	40			120	30	3.3×10^{-3}	68			
8A	136	180	44	21	1.5×10^{-3}	300	17	1.8×10^{-3}	120	22	2.4×10^{-3}	60
16A	141	172	31			265	32	4.9×10^{-3}	60	2.5 44	5.6×10^{-6} 6.7×10^{-5}	44
SUB SUB-ROBINSON												
9A	171	341	69							30 40	2.1×10^{-3} 2.7×10^{-3}	45

[a] Calculated using Q as the Recovery rate in gpm.

[b] Values given by Van Voast and Hedges, written communication, 1974.

Table 14. -- Transmissivity$^{(T)}$ and permeability$^{(K)}$ of geologic units tapped by observation wells in the Sarpy Creek Project Area (Westmoreland Resources 1975d)

(Cont'd.)

AQUIFER NAME-WELL NUMBER	GRAVEL INTERVAL (feet) FROM	GRAVEL INTERVAL (feet) TO	TESTED THICKNESS (feet)	PUMPING T (gpd/ft)	PUMPING K (cm/sec)	PUMPING LENGTH OF TEST (min.)	RECOVERY T (gpd/ft)	RECOVERY K (cm/sec)	RECOVERY LENGTH OF TEST (min.)	FALLING HEAD T (gpd/ft)	FALLING HEAD K (cm/sec)	FALLING HEAD LENGTH OF TEST (min.)
ALLUVIUM - 10	2	20	18			.75	1.1^{a}	2.9×10^{-8}	25			
18	3	50	47	5280	3.3×10^{-5}	15	6813 11733	6.8×10^{-3} 1.2×10^{-2}	15			
29	3	40	37			15	1005 2640	1.3×10^{-3} 5.4×10^{-3}	15			
20	3	80	77			15	6212	3.8×10^{-3}	13			
ROSEBUD-McKAY OVERBURDEN												
4A	35	81	8			8	17	1.3×10^{-4}	15			
5A	48	63	17	634^{b}	1.8×10^{-3}	160^{b}	587	1.8×10^{-3}	31	725	2.0×10^{-3}	16
ROSEBUD-McKAY COAL												
2A	15	45	30	14	2.2×10^{-5}	25	21	3.3×10^{-5}	60			
3A	112	142	30				4.6	7.2×10^{-6}	15			
4B	70	111	41	5	3.8×10^{-6}	130	9	1.0×10^{-5}	40	4.07	4.7×10^{-6}	55
5B	91	135	44	35^{b}	3.8×10^{-5}	60^{b}	3.1^{a}	3.3×10^{-6}	17	44.5	4.8×10^{-5}	45
6A	70	110	40	3^{b}	1.2×10^{-6}	60	3.5^{a}	4.2×10^{-6}	20	3.5	5.9×10^{-6}	45
8C	68	100	32			17	1.6^{a}	2.7×10^{-8}	17	7.5 9.4	1.1×10^{-5} 1.4×10^{-5}	55
INTERBURDEN												
14B	131	170	39	7.3	8.8×10^{-6}	60	8	9.7×10^{-6}	60	28 36	5.4×10^{-5} 4.4×10^{-5}	60
ROBINSON COAL 1A	48	71	24	14	2.8×10^{-5}	120	21	4.1×10^{-5}	60			
2B	105	125	20	2.9^{b}	6.8×10^{-6}	120^{b}	2.3^{a}	5.4×10^{-6}	20	5.9	9.2×10^{-6}	50
3B	195	215	20			15	1.4^{a}	3.3×10^{-6}	25			
4C	165	212	47			60	2.4 12.5	2.4×10^{-8} 1.3×10^{-5}	485	17.8	1.8×10^{-5}	60
5C	247	267	20	3^{b}	7.1×10^{-8}	120^{b}	4.7^{a}	1.2×10^{-5}	33	2.2	5.2×10^{-6}	60
6B	275	296	21	13^{b} 21	2.9×10^{-5} 4.7×10^{-5}	110^{b} 120	8	1.8×10^{-5}	60	12	2.7×10^{-5}	60
8B	141	185	44			15	2.2^{a}	3.0×10^{-6}	15	1.8	5.7×10^{-6}	75
25B	70	97	27			15	5.1^{a}	5.4×10^{-6}	15			
26B	65	100	35			15	2.7^{a}	2.3×10^{-6}	18	1.8	2.4×10^{-6}	48
SUB-ROBINSON												
1B	85	125	40	87	1.0×10^{-4}	120	56	6.6×10^{-5}	289			
2C	172	232	60	469 508	3.7×10^{-4} 4.0×10^{-4}	150^{b} 890	131 633^{b}	1.0×10^{-4} 5.0×10^{-4}	50 60^{b}	62 314	7.5×10^{-5} 3.8×10^{-4}	20
3C	250	290	40			120	30	5.5×10^{-5}	48			
8A	238	280	44	21	2.5×10^{-5}	300	17	1.8×10^{-5}	120	22	2.4×10^{-5}	60
16A	141	171	31			265	32	4.9×10^{-5}	60	2.5 44	3.8×10^{-6} 8.7×10^{-5}	64
SUB SUB-ROBINSON												
9A	172	341	69							30 40	2.1×10^{-5} 2.7×10^{-5}	45

[a] Calculated using Q as the Recovery rate in gpm.

[b] Values given by Van Voast and Hedges, written communication, 1974.

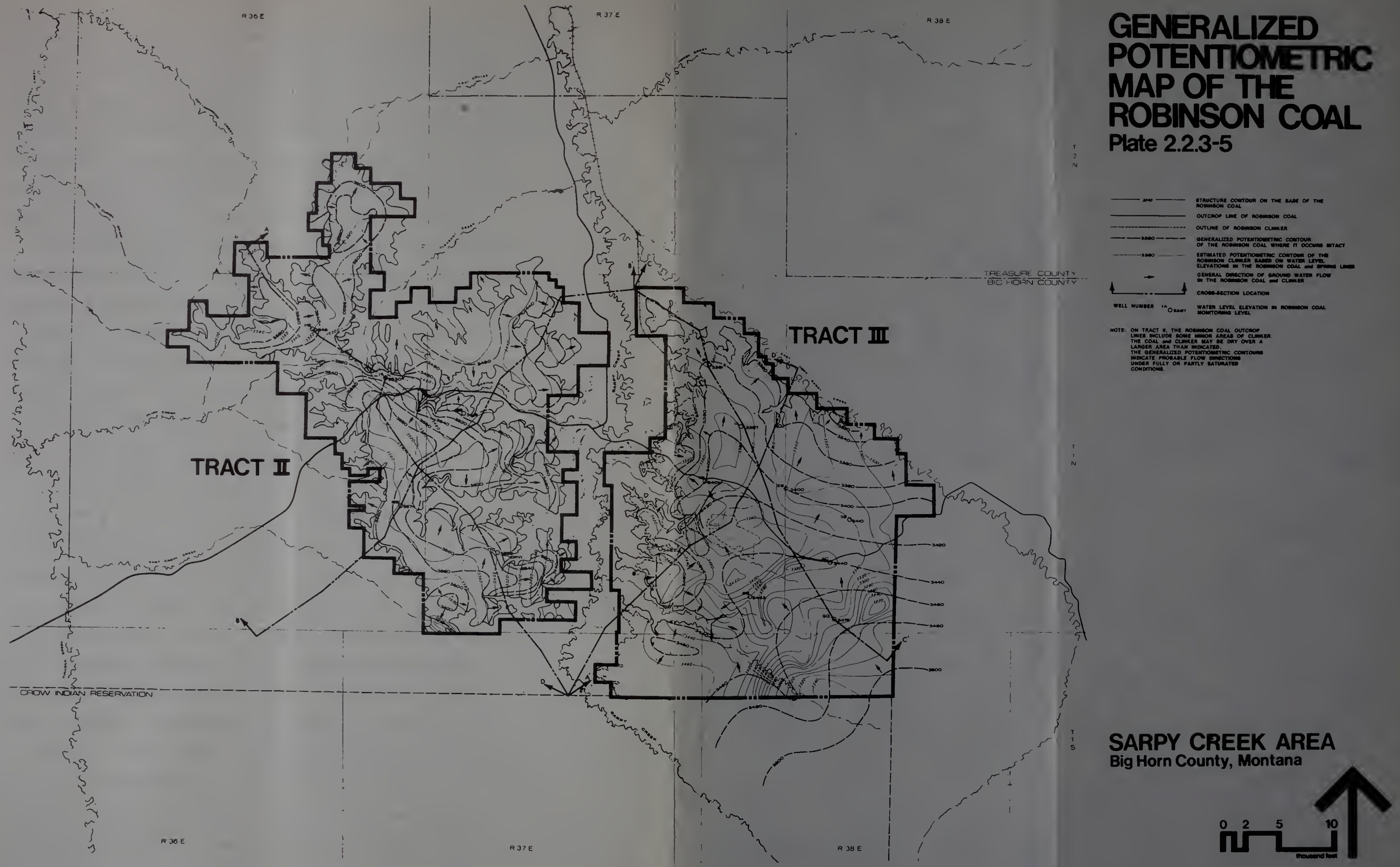

GENERALIZED POTENTIOMETRIC MAP OF THE ROBINSON COAL
Plate 2.2.3-5
3440 STRUCTURE CONTOUR ON THE BASE OF THE ROBINSON COAL
OUTCROP LINE OF ROBINSON COAL
OUTLINE OF ROBINSON CLINKER
3380 GENERALIZED POTENTIOMETRIC CONTOUR OF THE ROBINSON COAL WHERE IT OCCURS INTACT
3380 ESTIMATED POTENTIOMETRIC CONTOUR OF THE ROBINSON CLINKER BASED ON WATER LEVEL ELEVATIONS IN THE ROBINSON COAL and SPRING LINES
GENERAL DIRECTION OF GROUND WATER FLOW IN THE ROBINSON COAL and CLINKER
CROSS-SECTION LOCATION
WELL NUMBER 1A 3347 WATER LEVEL ELEVATION IN ROBINSON COAL MONITORING LEVEL
NOTE: ON TRACT II, THE ROBINSON COAL OUTCROP LINES INCLUDE SOME MINOR AREAS OF CLINKER. THE COAL and CLINKER MAY BE DRY OVER A LARGER AREA THAN INDICATED. THE GENERALIZED POTENTIOMETRIC CONTOURS INDICATE PROBABLE FLOW DIRECTIONS UNDER FULLY OR PARTLY SATURATED CONDITIONS.
R 36 E
R 37 E
R 38 E
T 2 N
T 1 N
T 1 S
TRACT II
TRACT III
TREASURE COUNTY
BIG HORN COUNTY
CROW INDIAN RESERVATION
SARPY CREEK
3400
3440
3480
3480
3500
SARPY CREEK AREA
Big Horn County, Montana
0 2 5 10
thousand feet

Figure 9B.--Generalized potentiometric map of the Robinson coal (Westmoreland Resources, 1975d)

the top of the coal in the northeastern part of the tract. Recharge is from the southeast. The southeast-northwest trending axis of a groundwater divide passes part to the northeast of Section 36, with waters east of the axis flowing toward East Fork Sarpy Creek, and waters west of the axis flowing towards the Middle Fork. Where the Rosebud-McKay has burned, the flow pattern is maintained by clinker.

The Rosebud-McKay and Robinson seams are separated by approximately 60 feet of interburden, comprising interbedded sandstones and shale, as well as the Stray 2 coal seam (figure 4). Overlying the Stray 2 seam is a 10-foot thick shale zone which probably has low permeability. Below the Stray 2, however, the interfingering sandstones and shale probably maintain varying degrees of permeability and saturation. With complex interbedding of permiable and impermiable zones, the interburden could be saturated where permiable sandstones lie directly above the Robinson coal seam. As indicated by figure 9B, the potentiometric levels of the Robinson coal seam indicate that groundwater could rise into permiable zones immediately above the coal.

Figure 9B also indicates flow conditions in the Robinson coal fracture. Permeability of the Robinson through Tracts II and III runs from about 2×10^{-6} cm/sec. to 5×10^{-5} cm/sec. (Westmoreland Resources, 1975d). Robinson coal is saturated in about all of Tract III, including the Section 36 area, with vertical recharge being low compared to lateral recharge from the southeast. One spring flows from the Robinson seam in the valley of the Middle Fork.

B. Biological Environment

1. Vegetation

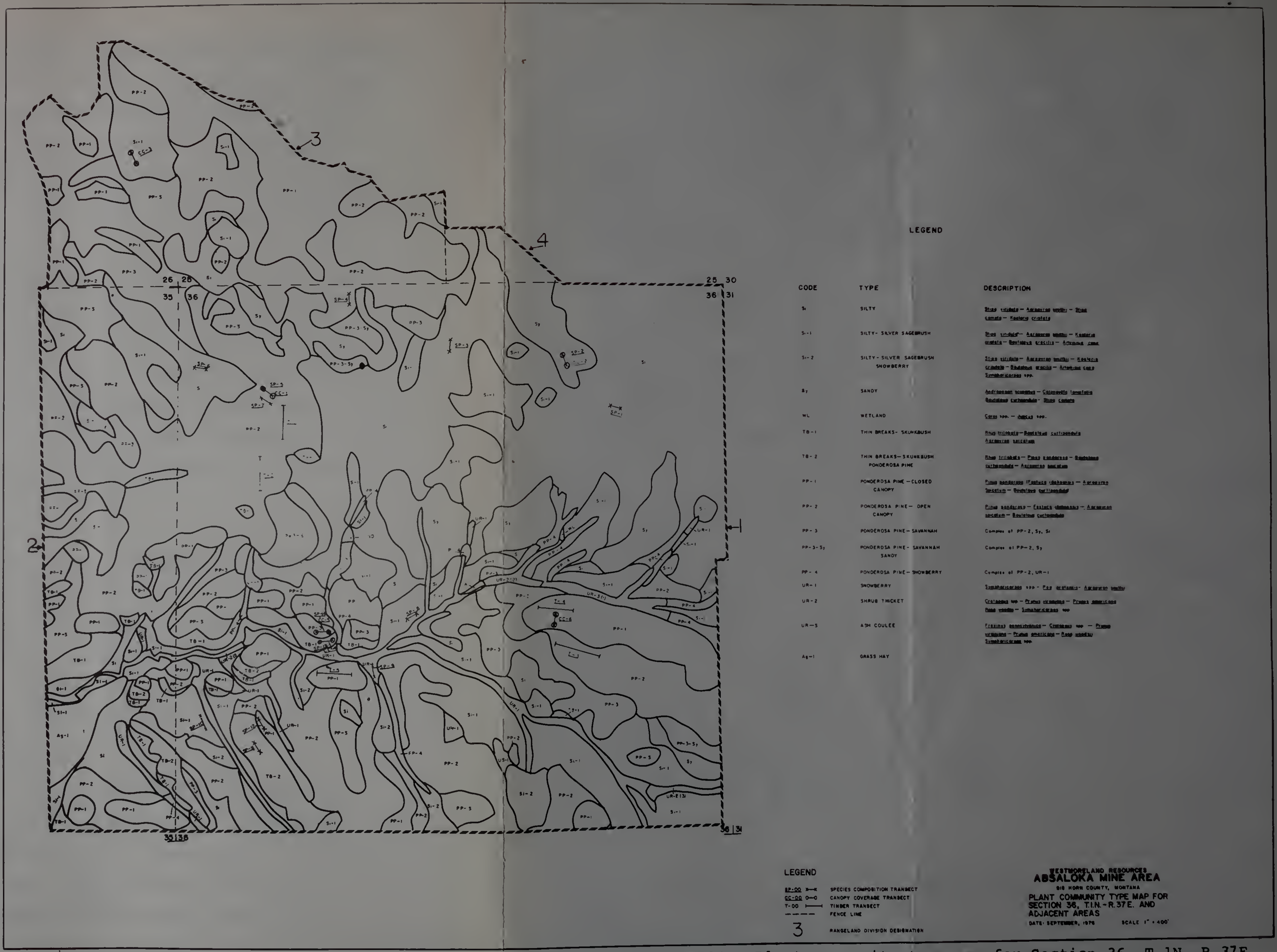
Westmoreland Resources (1976b) describes Section 36, T.1N., R.37E. and the vegetation within it as follows:

> ... a moderately to highly dissected plain of the Fort Union geologic formation. Elevation ranges from 3200 to 3800 feet; the average annual precipitation is about 15.0 inches. The area is within the grassland biome and is within a broad band of overlap between the mixed prairie to the east and the bunchgrass or Palouse prairie to the west. Ponderosa pine has developed where soil and moisture conditions are suitable.

The dissected nature of the proposed mine area creates a highly diverse vegetative pattern. Nearly level areas of the northeast portion of the section are primarily grasslands (figure 10). The bluffs to the west and south create moister conditions resulting in shrub and tree stands. Trees are generally located on slope areas with the heavier stands on the shaded north aspects and more sparse stands on the southerly aspects. Shrub communities are found on slopes and in the coulee bottoms.

Shrub communities grade from skunkbush sumac on the dry south slopes, to snowberry stands on the moister slopes and coulee bottoms, to ash-hawthorn stands in coulee bottoms with naturally irrigated or subirrigated qualities. In some of the wider bottoms, lush grass stands are found intermingled with shrubs.

As a result of its relatively moist nature, Section 36 is highly productive when compared to surrounding state-owned sections. DSL files indicate a carrying capacity of



LEGEND

CODE	TYPE	DESCRIPTION
Si	SILTY	*Stipa viridula* – *Agropyron smithii* – *Stipa comata* – *Koeleria cristata*
Si-1	SILTY- SILVER SAGEBRUSH	*Stipa viridula* – *Agropyron smithii* – *Koeleria cristata* – *Bouteloua gracilis* – *Artemisia cana*
Si-2	SILTY- SILVER SAGEBRUSH SNOWBERRY	*Stipa viridula* – *Agropyron smithii* – *Koeleria cristata* – *Bouteloua gracilis* – *Artemisia cana* *Symphoricarpos* spp.
Sy	SANDY	*Andropogon scoparius* – *Calamovilfa longifolia* *Bouteloua curtipendula* – *Stipa comata*
WL	WETLAND	*Carex* spp. – *Juncus* spp.
TB-1	THIN BREAKS- SKUNKBUSH	*Rhus trilobata* – *Bouteloua curtipendula* *Agropyron spicatum*
TB-2	THIN BREAKS– SKUNKBUSH PONDEROSA PINE	*Rhus trilobata* – *Pinus ponderosa* – *Bouteloua curtipendula* – *Agropyron spicatum*
PP-1	PONDEROSA PINE – CLOSED CANOPY	*Pinus ponderosa* (*Festuca idahoensis* – *Agropyron spicatum* – *Bouteloua curtipendula*
PP-2	PONDEROSA PINE – OPEN CANOPY	*Pinus ponderosa* – *Festuca idahoensis* – *Agropyron spicatum* – *Bouteloua curtipendula*
PP-3	PONDEROSA PINE – SAVANNAH	Complex of PP-2, Sy, Si
PP-3-Sy	PONDEROSA PINE - SAVANNAH SANDY	Complex of PP–2, Sy
PP-4	PONDEROSA PINE – SNOWBERRY	Complex of PP-2, UR-1
UR-1	SNOWBERRY	*Symphoricarpos* spp. - *Poa pratensis* - *Agropyron smithii*
UR-2	SHRUB THICKET	*Crataegus* spp. – *Prunus virginiana* – *Prunus americana* *Rosa woodsii* – *Symphoricarpos* spp.
UR–5	ASH COULEE	*Fraxinus pennsylvanica* – *Crataegus* spp. – *Prunus virginiana* – *Prunus americana* – *Rosa woodsii* *Symphoricarpos* spp.
Ag–1	GRASS HAY	

LEGEND

SP-00 ✕—✕	SPECIES COMPOSITION TRANSECT
CC-00 ○—○	CANOPY COVERAGE TRANSECT
T-00 ├──┤	TIMBER TRANSECT
– – – – –	FENCE LINE
3	RANGELAND DIVISION DESIGNATION

WESTMORELAND RESOURCES
ABSALOKA MINE AREA
BIG HORN COUNTY, MONTANA
PLANT COMMUNITY TYPE MAP FOR
SECTION 36, T.1.N. - R.37E. AND
ADJACENT AREAS
DATE: SEPTEMBER, 1976 SCALE 1" = 400'

Figure 10.--Plant community type map for Section 36, T.1N. R.37E.
and adjacent areas
(submitted to DSL by Westmoreland Resources in September, 1976)

240 Animal Unit Months (AUM) or .38 AUM's/acre (see Appendix D). This is 46% higher than the average of .26 AUM's/acre for 80 surrounding state sections and is 12% higher than the next productive section. A rating of 240 AUM's is recorded for the proposed mine area despite the fact that the section has sizable areas of dense timber, shrub communities and steep, relatively barren slopes.

In describing the vegetation communities within Section 36, Westmoreland identified 15 native community types and subtypes and one agricultural type (Westmoreland Resources, 1976 and figure 10). These types were defined on the basis of soils, aspect, and species composition. A complete description for each of the sites is given in Appendix E. Vegetation transect data for proposed mine area is on file in DSL's offices in Helena, Montana.

2. Wildlife

Wildlife data for Tract III is included in reports by Ecological Consulting Service (1974, 1975, 1976) and in environmental impact statements prepared by the U.S. Bureau of Indian Affairs (1976) and the U.S. Geological Survey (1976). A listing of the mammals and birds observed or potentially occurring in the vicinity of the proposed mine area is included in Appendix F.

The interspersion of vegetation cover types within the proposed mine area (Section 36, T.1N., R.37E.) provides good to excellent habitat conditions for a wide variety of wildlife species. Game animals most commonly observed within the proposed mine area include mule deer, sharp tailed grouse and Merriams turkey. Other species frequently observed include numerous perching birds and raptors.

Distribution of wildlife habitat within the proposed mine area is to a large degree a function of subsurface geology. Rough breaks covered with Ponderosa Pine are found in those areas to the south and west of the Rosebud-McKay burn line and a more gentle grassland ecosystem is found in those areas to the north and east of the burn line (see figures 2 and 10). The creek bottom bisecting Section 36 and areas immediately adjacent to it contain the most diverse arrangement of vegetation types within the proposed mine area.

Areas south and west of the burn line (including the majority of the drainage bottoms within the proposed mine area) are more valuable to local wildlife species than is the remainer of Section 36 because of the diverse topographic and vegetative features of this area. Such diversity increases the amount of edge between habitat types, an important component of wildlife habitat. It also increases the assortment of wildlife foods, another important component of quality wildlife habitat.

Of particular concern to DSL is an area of south-facing scoria slopes in the southwest corner of Section 36, an area vegetated primarily with skunkbrush sumac and frequently utilized as a wintering area by mule deer and other species. The Ecological Consulting Service (1976) reports repetitive use by mule deer in this area and also includes the area within its general distribution map for Merriams turkey. The adjacent drainage bottom has been observed to be an important mule deer winter use area by DSL personnel as well as by the Ecological Consulting Service (1976).

C. Human Environment

1. Demographics

In 1970 the population of Big Horn County was 10,057 which represented a .5 percent increase over the 1960 population (U.S. Bureau of Census, 1970). In November, 1976, the county population was 10,619, indicating that the population had grown by .6 percent since 1970 (U.S. Bureau of Census, 1976a).

By contrast, the city of Hardin lost 2 percent of its population during the 1960-1970 interval but experienced an approximately 15% increase during 1970-1975. Hardin is the county seat for Big Horn County and is the residence for many Westmoreland employees. During 1970-1975, Hardin increased from 2,733 to from 3,100 to 3,200 persons (Mountain West Research, 1975). Census figures for communities in Big Horn County (1970 data) are given in table 15.

The Crow Indian Reservation composes a major portion of Big Horn County. The BIA (1976) reports that 5,368 members of the Crow Tribe live in Montana - 4,269 on the Crow Reservation and the majority of the remainder living adjacent to it. Crows living adjacent to the reservation reside primarily in the towns of Billings and Hardin.

The Crow population has been growing much faster than Big Horn County population as a whole. During 1960-1970, the County population decreased 8.6% in Anglo residents (from 6,584 to 6,018) while the Indian population increased 17.5% (3,334 to 3,917) (U.S. Bureau of Census, 1976a).

Table 15.-- 1970 population for selected communities in Big Horn County, Montana
(U.S. Bureau of Census, 1970)

Community	Population
Hardin	2,733
Lodge Grass	806
Crow Agency	600
Busby	300
Fort Smith	125
St. Xavier	100
Wyola	100
Pryor	50
Decker	5
Garryowen	5
Kirby	----
Quietus	----

2. Land use

Agriculture is the primary land use for Big Horn County (figure 12). From 1969-1974, the number of farms and total acreage of farmland in the county decreased slightly (figures 12 and 16). During the same period, however, the average farm size increased to a small degree (U.S. Bureau of Census, 1976b).

Lands within the Tract II and III area are used primarily for grazing, with only about 12% being cultivated. In 1975 cultivation amounted to about 100 acres in Tract II and

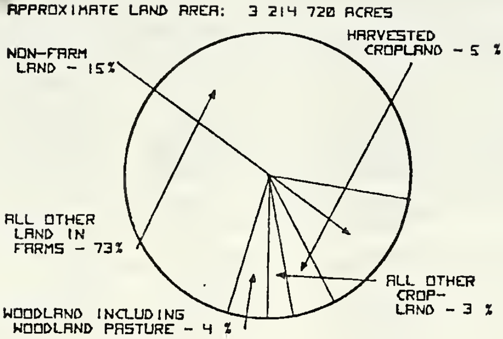


Figure 11. - Land use in Big Horn County, 1974
(U.S. Bureau of Census, 1976b)

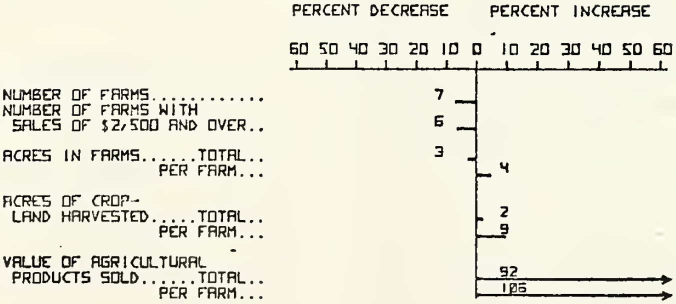


Figure 12. - Changes in Big Horn County agriculture: 1974 from
1969 as measured by the census of agriculture
(U.S. Bureau of Census, 1976b)

Table 16. -- Selected farm statistics, Big Horn County, Montana

(U.S. Bureau of the Census, 1976b)

		ALL FARMS		FARMS WITH SALES OF $1,000 AND OVER	
		1974	1969	1974	1969
ALL FARMS	NUMBER..	503	540	489	505
LAND IN FARMS	ACRES..	2 741 906	2 816 994	2 739 314	2 815 022
AVERAGE SIZE OF FARM	ACRES..	5 451	5 217	5 602	5 574
FARMS WITH SALES UNDER $2,500	NUMBER..	69	77	55	42
TOTAL CROPLAND	FARMS..	407	492	403	471
	ACRES..	250 931	294 794	250 904	293 449
FARM PRODUCTION EXPENSES, TOTAL	$1,000..	28 742	15 076	28 734	15 034
VALUE OF AGRICULTURAL PRODUCTS SOLD, TOTAL	$1,000..	34 220	17 809	34 217	17 788
AVERAGE PER FARM	DOLLARS..	68 032	32 980	69 973	35 224
CROPS, INCLUDING NURSERY PRODUCTS AND HAY	$1,000..	12 875	5 479	12 875	5 474
FOREST PRODUCTS	$1,000..	38	(Z)	38	(Z)
LIVESTOCK, POULTRY, AND THEIR PRODUCTS	$1,000..	21 306	12 330	21 303	12 314
CATTLE AND CALVES, INVENTORY	NUMBER..	132 299	125 473	132 254	125 290

1,575 acres in Tract III (Mountain West Research, 1975). Areas of past production amounted to 985 acres of Tract II and 680 acres of Tract III. As of mid-1975, there were seven occupied residences in Tract III, of which two were permanent structures and five were mobile homes (Mountain West Research, 1975).

The past several years have not been very favorable for the western range livestock industry (Montana Dept. of State Lands, 1976b). The Montana Crop and Livestock Reporting Service reports (personal communication) that production expenses continued to rise during 1976. The average price of cattle has also recently risen above previous levels - from $284.00/head in 1975 to $350.00/head in 1976. These prices, however, are considerably lower than the $443.00/head price received in 1973. The calf crop throughout the state was good in 1976.

Land values in non-mining impacted areas of Big Horn County have not changed appreciably over the past several years. In Tracts II and III, however, range and farmland which had a combined average market value of $137/acre five years ago is now worth $1300-1500/acre (personal communication, Big Horn County appraiser).

3. Economics

Average 1970 income of workers living in Hardin was $8,600, compared to $7,310 for Big Horn County and $8,512 for Montana (Mountain West Research, 1975). Inflation aside, this difference is probably greater today because of an increase of employment associated with the Absaloka mining operation. The July, 1975 unemployment level for Hardin was 5.6%, a level slightly lower than the national average of 6% at that time. A recent random sample of 95 households in Hardin gave the employment breakdown reported in table 17.

In 1970, Crow families averaged about $5,700/year while white families in the same area (personal communication, Treasurer, Big Horn & Rosebud Counties), averaged about $9,100. Table 18 compares the percentage of whites and Crows for nine income intervals.

Differences between Indian and non-Indian incomes are greatest in the Hardin District where, in 1970, white family income averaged over $11,000 while Crow family income averaged about $3,300. In Yellowstone County, Crow and White incomes were closer to parity, at $7,900 and $9,400, respectively.

In March, 1976, the BIA reported that the Indian labor force on the Crow Reservation totaled 1,526 (BIA Labor Force Report, March, 1976). Of this total, 597 (39%) were unemployed and 402 (26%) were actively seeking work. A 1970 employment profile of Indian and non-Indian males on the Crow Reservation and in the city of Hardin is presented in table 19.

As of mid-1975, the Absaloka mine provided employment for about 100 persons including employees of both Westmoreland Resources and their mining contractor, Morrison-Knudsen. Approximately 47 of these employees were white and approximately 53 were members of the Crow Tribe or were Crow-related. These figures have not changed significantly during 1976 and 1977. Turnover rate among mine employees is about 3 percent annually (personal communication, Ralph Moore, Vice President-Operations for Westmoreland Resources).

Table 17.-- Employment structure by major occupational groupings for the State of Montana (1970) and the city of Hardin (1975) (compiled by Mountain West Research)

Major Groupings	Montana, 1970 (Male employed, 14 years and older) Percent of Population	Hardin, Montana, 1975 (Employed, 19 years old and older)* Percent of Population
Professional, technical, and kindred workers	12.0	13.7
Managers and administrators, except farm	12.2	31.4
Sales Workers	5.8	----
Clerical and kindred workers	5.0	3.9
Craftsmen, foremen, and kindred workers	17.9	17.6
Operatives, except transport	8.7	9.8
Transport equipment operatives	5.3	3.9
Laborers, except farm	6.4	11.8
Farmers and farm managers	10.7	2.0
Farm laborers and foremen	5.2	----
Service workers, except private household	6.9	5.9
Private household workers	0.1	----
Occupation not reported	4.0	----
	100.0	100.0

---

* Includes female household heads.

Source: U.S. Bureau of the Census, U.S. Census of the Population: 1970 General Social and Economic Characteristics, Washington, D.C., 1971.

Table 18. -- Comparison of Crow Indians and Whites falling within nine income intervals
(compiled by Mountain West Research, 1975)

Income	Crow	White
$ 999 or less	12%	4%
$ 1,999 or less	19	7
$ 2,999 or less	31	14
$ 3,999 or less	37	23
$ 4,999 or less	48	29
$ 5,999 or less	80	58
$11,999 or less	90	77
$14,999 or less	98	89
$24,999 or less	100	98

---

[a] Percentages are rounded and cumulative.

Source: Compiled from 1970 U.S. Bureau of the Census Fourth Count Sample Data supplied by the Montana State Department of Community Affairs.

Table 19. -- Employment by occupation for the Crow Indian Reservation and for the city of Hardin, Montana males 16 years and older, 1970
(compiled by Mountain West Research, 1975)

	Indian		Non-Indian	
	number	percent	number	percent
Professional, Managerial, and Kindred Workers	82	21.3	431	22.9
Craftsmen, Foremen, and Kindred Workers	39	10.1	307	16.3
Operatives, including transport	92	23.9	176	9.3
Laborers except farm	53	13.8	100	5.3
Farmers and Farm Managers	29	7.5	431	22.8
Farm Labors, except unpaid and Farm Foremen	68	17.7	188	10.0
Other	22	5.7	253	13.4
Total	385	100.0	1,886	100.0

Source: U.S. Bureau of Census, 1970

4. Social structure

There are three groupings within the populace of Big Horn County who will be most directly affected by coal development. The first of these comprise the residents of Hardin and Crow Agency - the two towns most likely to feel any stress placed on municipal services by a change in population parameters. The second group is the Crow Tribe whose members stand to benefit economically from development but who also may experience disruptions in tribal customs. The third group comprises ranchers on Tracts II and III. Because of continued coal development in the Sarpy Creek area these individuals could be faced with moving to ranches in other areas and with other serious disruptions of their lives.

A fourth group of Big Horn County residents affected by coal development are white residents of the smaller towns and non-impacted ranchers. These individuals are likely to benefit through reduction of county taxes or potential increase in services as development proceeds. The Big Horn County's mill levy for 1974, 1975, and 1976 was 42.22, 26.72 and 20.34 respectively (U.S. Bureau of Indian Affairs, 1976). The Big Horn County assessor (personal communication) attributes such progressive mill reductions to the increase in taxable facilities at the Decker and Westmoreland mine sites. It should also be noted, however, that the city of Hardin's mill levy increased during the same period, possibly as a consequence of additional stress imposed upon its services.

In 1975 a survey was made among Hardin residents to determine their perceptions regarding development at the Absaloka mine (Mountain West Research, 1975). Only 13.9% of those surveyed felt that they had observed no changes in local conditions as a result of development. According to Mountain West Research (1975):

> Population increases represented the largest single category of responses (16.3 percent). Some of the respondents viewed it positively, but others viewed it negatively and still others were ambivalent. Along with growth has come a changed cost of living (8.3 percent), and there was some disagreement as to whether this was positive or negative. A rather high proportion of the respondents stated that increased employment was a beneficial change (11.1 percent), with 1.4 percent acknowledging that the Indians had more income and more jobs. The idea of progress claimed several responses (12.5 percent).

According to Mountain West Research, the majority of Hardin residents perceived no problems associated with energy development, and:

> The problems perceived and specified by the respondents are those that can be solved by an influx of dollars, and none are what would normally be considered as strictly social problems. Although strains on housing, sewer and school systems increased, strains on medical services and the tax structure decreased. It appears that while increased employment and income solved some problems--unemployment and a strained tax structure--they simultaneously created other problems--such as strains on housing and the school system.

The majority of respondents viewed economic benefits as the most important positive aspect of Westmoreland development.

The long-term effects of Westmoreland employment on the Crow Tribe is difficult to estimate at present. So far, it does not seem to have caused appreciable changes in population distributions within the Reservation. According to Mountain West Research, (1975):

> The majority of Crow workers at the Westmoreland Mine currently reside in either Crow Agency or Hardin (24 of 40) and only five of the 40 changed their place of residence after obtaining jobs at the mine. Only one of the five came from outside Montana (a college student who works summers only). The 16 Crows who do not live in Crow Agency or Hardin are scattered in six residential areas (Garryowen, Lodge Grass, Pryor, rural Hardin, Kirby, and Sarpy Creek). Commuting distances for these workers (except the single Sarpy Creek resident) are substantial, and Morrison-Knudsen reimburses all employees for travel expenses. Hardin workers travel at least 60 round-trip miles daily and those living in Crow Agency travel about 80 miles. Although commuting distances are lengthy, all 29 workers interviewed expressed satisfaction with present wages and most of them resigned from full-time jobs nearer their residences in order to have substantially higher incomes at the mine.

While Crows working at the mine seemed basically satisfied, the tribe as a whole remains uncertain as to the desirability of coal development. Mountain West Research, (1975) found that over 85% of Crows sampled wanted a moratorium on mining development on the Reservation, with the majority feeling that at least one year's study was needed. Those interviewed were not asked about development in the ceded area; however, in December, 1976, the Crow Tribal chairman announced that the tribe would oppose approval of the pending USGS environmental impact statement for mining the ceded area because of deficiencies in rural and economic evaluation of mining impact.

Regarding coal development on the Reservation, 47% indicated that they would favor such development after a study period, while 33% were opposed and 18% had no opinion (Mountain West Research, 1975).

The Absaloka mine is not located on the Reservation and is not near Hardin, Lodge Grass, or any of the other towns on the Reservation area. Those people most affected by the mining are the ranchers living on the ceded area. According to Mountain West Research, (1975):

> The Sarpy Creek Basin has supported a sparsely populated ranching community since the early 1900's. Although the population composition has changed over the past couple of years with several of the long-resident ranchers moving away and some mine workers migrating in, the majority of the residents today are still ranchers and farmers. The ranching families of Sarpy Creek support themselves through the raising of cattle and the growing of dry crops. Of the nine families interviewed, three have lived in their present location 50 or more years, another three have lived there 24 to 28 years, while the rest have been there 10 to 12 years. Although the productivity of the land varies seasonally according to the amount of rainfall in this semi-arid region, these residents who have endured both the good and bad forces of nature for many years consider life there economically and personally rewarding.

The majority of persons in the 11 families living on Tracts II and III (80%) expressed negative attitudes towards mining development. Those interviewed stated five major unfavorable aspects (Mountain West Research, 1975):

Too many people. About 100 people commute daily to the mine to work. This represents a significant influx of people relative to the rural resident population.

Pollution and traffic. In conjunction with the additional people, there has been a substantial increase in traffic along the roughly graveled county road. This has caused dust and visibility problems especially during work shift changes at the mine, as well as operational difficulties in moving cattle and transporting equipment. This road is to be paved during 1977.

Blasting effects. Most of the residents' homes, whether frame or log, shake when there is blasting at the mine. Several families claimed the blasting was severe enough to crack windows and plaster, although it is difficult to distinguish the structural consequences of blasting from those of the frequent sonic booms in the area.

Social disruptions. Two families expressed their dislike for the mining project because other family members and friends have moved away and they feel others are likely to do so in the future. In addition, mining has caused some breakdown of relations between area families because of differing attitudes toward selling of land.

Permanent changes to the landscape. With regard to future changes from mining, most residents expressed concern that, whether the land was reclaimable or not, the landscape would be permanently altered by the removal of trees, destruction of rock outcroppings and changes to the land's contours.

Attitudes toward the land's reclamation potential were varied. Three people interviewed felt that the land can be reclaimed if it is properly done, two did not have any clear opinions, and four felt that the land will not be reclaimable.

5. Social services

a. Housing

(1) Hardin

A housing shortage exists in the city of Hardin but the situation has been eased over the past year (1976) by the construction of about 30 single-family dwellings (Murdock Realty, realtor, personal communication). Hardin's housing situation was described by Mountain West Research (1975) as follows:

> As of August, 1975, Hardin had an estimated total of 1,193 housing units (1970 Census and Building Permit Data). This total consists of 751 single-family units, 54 duplex units, 57 three- and four-plex units, 154 apartments, and 154 mobile homes. Since 1970 approximately 185 new units have been added, nearly half

of which are mobile homes. When the development of the Westmoreland Resources mine began, Morrison-Knudsen established a trailer court in Hardin for its employees which eased the potential pressure on housing from this source although only 34 men at the Westmoreland mine are newcomers to Hardin (Employee Records, Morrison-Knudsen Personnel Office, July, 1975). The houses are mostly in good condition, although half of them are more than 30 years old. The housing situation in Hardin is tight but less so than in other nearby towns. There is a fairly steady turnover despite the fact that there is a shortage of houses for sale and a severe shortage of rental units. An average three-bedroom home sells for about $30,000 while rentals vary from $150-$200 for houses and $75-$125 for apartments (Realtor, Murdock Realty, Hardin, Montana, personal communication, August, 1975).

(2) Crow Reservation

Housing on the Crow Reservation was described by Mountain West Research, (1975) as follows:

> The Bureau of Indian Affairs completed an inventory of Indian housing in April of 1975. Results of the survey estimated the total number of Indian families on the reservation as 1,090. Of this number, 615 were living in Indian owned and occupied housing while 475 were renting or living with others but not paying rent.
>
> Overcrowdedness is a common problem in reservation housing. In 1970, 249 households on the reservation contained more than seven people, yet only 132 houses had seven or more rooms. A BIA consolidated housing inventory as of June 30, 1975 reported that the total number of existing housing units occupied by Indians stood at 597.5. Of this reported total, 323 are in standard condition, while 274 are substandard. Of the substandard units, 187 are in such condition that they should be replaced, while 87 need renovations to bring them up to the "standard" level. In summary, many of the Indian families are living in housing that is either substandard and/or overcrowded, and these problems are probably most acute in the heavily populated Lodge Grass/Crow Agency area (BIA, "Inventory of Indian Housing," 1975).
>
> Within the towns of Lodge Grass, Crow Agency, and Wyola, the number of housing units in 1975 was estimated to be 250 (Intermountain Planners 1974, p. 146), 225 (BIA Crow Agency Housing Coordinator, personal communication, June, 1973), and 37 (BIA Crow Agency Housing Coordinator, personal communication, June, 1973), respectively, including both Indian and non-Indian occupancies. Approximately

> 38 percent of the housing units in Lodge Grass are considered substandard and slightly less than half of these are in a dilapidated state (Intermountain Planners, 1974, p. 146). Within Wyola, about five of the homes are in need of renovation or replacement. Housing conditions in Crow Agency vary from standard to dilapidated; however, the distribution of housing by condition is not known.
>
> Lack of adequate plumbing systems add to other housing problems that include overcrowdedness and poor structural condition. An estimated 17 percent of all housing units lacked some plumbing and toilet facilities in 1970. Of the total population in over-crowded housing (2,991 people), 2,266 lived in units with plumbing and 725 lived in units without plumbing (Intermountain Planners, 1974, p. 143).

b. Water systems

(1) Hardin

The following sections on water systems, sewer systems, solid waste disposal, fire control, health facilities, law enforcement and schools and recreation facilities were prepared by Mountain West Research, (1975) for Westmoreland Resources and are herein directly quoted:

> Hardin is served by a central water system, the source of which is the Big Horn River east of town. The pumping station at the river is designed to deliver about 1,400 gallons per minute (gpm) to the treatment plant (Water Superintendent, Hardin, personal communication, 1975). Of the two pipes used in the delivery, the first, an 18" pipe that transports the water to the presettling basin, is adequate for present and future needs. The second, a 12" pipe that takes the water from the presettling basin to the plant, is at capacity (Mueller Engineering, Inc., January, 1974).
>
> The plant itself is a complete treatment facility where the water is filtered and chemically treated. The plant is designed to treat one million gallons per day (gpd) based on a 12-hour day. During a given 24-hour period, it could probably treat two million gallons; however, this could not be done on a regular basis. Peak day usage is about 1,628,000 gallons, (Daily Water Report Log Book, Hardin, Montana) although for the year, usage averages about 512,000 gallons per day. All parts of the plant are in serviceable condition except for the larger pump which should probably be replaced (Mueller Engineering, Inc., *op. cit.*).

The town would also like to have larger pumps installed at the river and replace the four rapid sand filters with carbon filters to increase the plant's capacity.

The distribution system consists of 6-, 8-, 10- and 12- inch mains (Mueller Engineering, Inc., January, 1975). The system is not at capacity and provides adequate flows and pressures throughout the town. The distribution system is in good shape (Water Superintendent, Hardin, personal communication, 1975).

At present there is a 500,000 gallon steel storage tank located on high ground west of town. A new tank is also being constructed, which will provide another 500,000 gallons of storage. This will be sufficient for meeting peak day and fire protection requirements (Water Superintendent, Hardin, personal communication, 1975)."

(2) Crow Agency

"The water system in Crow Agency serves 250-260 households. The water is drawn from the Little Big Horn River and there are no limits to the amount the community may use (BIA Crow Agency, Plant Manager, personal communication, August, 1975). The plant which has a capacity of 400,000 gpd, is about 10 years old and is in good condition. Average annual water use is roughly 145,000 gpd and peak use was 396,000 gpd although average use during the summer is about 210,000 gpd (Water Plant Log Sheets, December-August, 1975). After being pumped from the river, the water is filtered and treated chemically and meets state health standards (BIA Crow Agency, Plant Manager, personal communication, August, 1975).

The storage resevoir holds 750,000 gallons and is becoming too small for the expanding needs of the town. The distribution system is generally in good condition. Most of the system has been installed since 1967 and consists of transite and plastic pipes which vary from 4" to 8" in diameter. The lines have excess capacity so additional growth can be accomodated by adding new lines. Water pressures throughout the system are adequate (BIA Crow Agency, Plant Manager, personal communication, August, 1975).

There are no present plans for modifying the system although the manager would like to see the storage capacity increased. There is some talk of transferring the system from BIA to tribal authority since it would be easier for the tribe than for the BIA to get money for improvements. Future plans are awaiting settlement of this issue (BIA Crow Agency, Plant Manager, personal communication, August, 1975).

(3) Lodge Grass

Lodge Grass draws its water supply from three wells which together can pump 250 gpm or a maximum of 360,000 gpd. The water of one well, however, is of poor quality and the town would like to either improve the well or replace it. This well alone produces 150 gpm of the total supply. Water use averages 33,000 gpd in the winter months and 50,000-67,000 gpd in the summer, so water supplies are adequate for the present population.

The water meets state health standards without treatment and is piped directly into the distribution system. The main line is 10" and the feeder lines 4" and 6". Most of the lines are of steel and have developed problems with electrolysis although capacities are fine. The city has recently received a grant to repair streets and replace the water pipes in a six-block area. These new pipes will be 10" plastic pipes. The other pipes in the system will be replaced on a continuing basis as other repairs to the pipes or street are required. The storage tank, new in 1974, holds 200,000 gallons. Water pressures throughout the system are about 65 lbs. per square inch which is adequate.

The town is presently trying to get assistance through the public health service for improving the one well. There are no other future plans for the system although, if a proposed 40-unit housing project goes in, expansion of the system may be necessary (Lodge Grass City Clerk, personal communication, August, 1975).

c. Sewer systems

(1) Hardin

The town's sewage is handled by a two-cell lagoon system. The cells have a total surface acreage of 24.94 acres which, according to state standards, is sufficient for a population of about 3,500. Currently, about 3,000 people (everyone in town and six families outside of town who gave easements for the outfall line) use the system. Peak usage is about 425,000 gpd and average usage is about 300,000 gpd. The system is presently over capacity.

There are several physical problems associated with the system: steep banks, irregular cell floors, and periodic high water table. The combination of these inadequacies and overuse results in insufficient mixture with the air for the sewage to be neutralized; the effluent discharged from the lagoons, therefore, does not meet state standards.

The collection system consists of 10.4 miles of clay tile, transite, and plastic pipe ranging in size from 4" to 18" in diameter. The bulk of the system is 8" pipe. The system is in adequate shape, although some portions are marginal and should be updated. The major portion of the system has sufficient capacity to handle a population increase of 1,000; however, there are bottlenecks at some lift stations. The north end, in particular, is overloaded as are a few areas to the west and south where new subdivisions have been hooked up.

The sewer system needs to have existing problems corrected. Modifications will also be needed in order to meet state standards, effective in 1977, requiring all systems to have at least secondary treatment. One problem that will be encountered when updating the system will be the acquisition of land. There is no room to expand on the present site and the surrounding land is expensive. The town is currently preparing a study, financed by a state grant, to determine their needs (Engineer, Mueller Engineering, Inc., personal communication, August 20, 1975).

(2) Crow Agency

Crow Agency's 1,400 residents are presently served by a three-cell lagoon system but anticipate connecting with the sewage plant formerly used by the Big Horn Carpet Mill. The lagoon system has a total of nine surface acres which is adequate for about 900 people or about 90,000 gpd. Sewage waste is estimated to vary from about 123,000 gpd to 200,000 gpd or more. The sewer system is over-capacity and does not meet state health standards at this time (BIA Crow Agency, Plant Manager, personal communication, August 21, 1975).

The collection system, however, is in good shape. The pipes are of transite, clay, and plastic and vary in size from 4" diameter feeder pipes to 6", 8", and 12" mains. It is hoped that the sewer plant which was built originally to treat dye water from the carpet mill can be altered for use for the municipal sewer system. This plant has a capacity of about 300,000 gpd. The existing lagoon system could still be used and the plant could treat the effluent. The addition of the plant to the system would enlarge the system's capacity as well as enable it to meet state secondary treatment requirements which become effective in 1977.

(3) Lodge Grass

Lodge Grass is served by a two-cell lagoon system with a total of twelve surface acres which is generally sufficient for a population of 1,200. The effluent flows into the Little Big Horn River and meets state health standards. One cell was new in 1974 and the other extensively repaired in 1975 so the system is in good condition as well as having a slight excess capacity. The collection system, composed of 6" and 12" clay tile pipes, is in good condition and has sufficient capacity to handle future expansion. The extension of new plastic lines is all that will be required to service new developments. Currently there are no plans for the system, however, some changes may be required to meet new state standards which become effective in 1977 (City Clerk, personal communication, August, 1975).

d. Solid waste disposal

(1) Hardin

The solid waste disposal site for Hardin is a state qualified landfill. The site is provided by the town but maintained by the county and serves an estimated 4,000 people. Use rates are close to the national average of five lbs. per person a day or about 20,000 lbs. a day for the Hardin area. It is not known just how large the site is, but at its present rate of use it should be adequate for seven to ten more years (County Sanitarian, Big Horn, Rosebud, and Treasure Counties, personal communication, August, 1975). The municipally operated collection systems picks up trash twice a week in residential areas and once a day in the business area. The trash is emptied into a dry coulee and covered every day except Saturday and Sunday by a caterpillar tractor that is in good condition. There are no plans for future expansion (County Sanitarian, Big Horn, Rosebud, and Treasure Counties, personal communication, August, 1975).

(2) Crow Agency

Crow Agency has a state qualified landfill. The 10-acre site is owned by the Crow Tribe and maintained by the BIA. The site is maintained by one full-time employee who uses a "track" front end loader to push the garbage into a long pit and cover it. The machine is five or six years old and is in adequate condition. It is expected that the two-year-old site will be adequate for six or seven more years.

The garbage is collected by a private contractor who has agreements with the BIA, the Crow Tribe, the Indian Health Service, and individual residents. The trash is collected twice a week (BIA Crow Agency, Plant Manager, personal communication, August 21, 1975).

(3) Lodge Grass

Lodge Grass owns and operates its own solid waste disposal site. The present site is not a state qualified landfill. Located one mile south of town, the site is almost full and a new site will be necessary by fall of 1975. The town would like to acquire at least three acres and hopefully more. The town has several proposals for a site but has not yet acquired one. The present disposal site is maintained by one employee of the town who covers the waste about three times a week with a D-4 caterpillar tractor that is kept at the site. The tractor is in passable condition but will need replacement. The collection system is a municipal operation and garbage is collected once a week with a 1960 eighteen-yard compactor truck and taken to the landfill. The garbage truck is also in only fair condition (Lodge Grass City Clerk, personal communication, August, 1975).

e. Fire control

(1) Hardin

The Fire Department, which serves Hardin's incorporated area, is a 20-man volunteer Department with a rating of six, slightly better than average for a town of its size. The department has a 1967 Chevrolet supply truck, a 500 gpm pumping truck (1947), and a 1,000 gpm pumping truck (1962), all in good condition. Together, the pumpers can supply somewhat less than the 2,000 gpm recommended by the state insurance office. The town is trying to acquire a new truck with a 1,000 gpm pumper. The funding for it is dependent on the passing of a bond issue. Indications are that the bond will be approved. The station housing the fire trucks has about 2,400 square feet and is adequate for its present use. Water supplies and pressures have been sufficient in the past, and when the new 500,000 gallon storage tank is installed, the town will have adequate water for fire control (Fire Chief, Hardin, Montana, Personal Communication, August, 1975).

(2) Crow Agency

Crow Agency has a volunteer department with 20 men and, as of last year, a class eight rating.

Their equipment consists of a 1974 Ford 500 gpm pumper with a 500-gallon water tank and a Seagraves which is frequently used as a hose truck because it does not have a booster. It is good hooked up to a hydrant, however, and pumps about 750 gpm. If needed, the town would also have the use of the Forestry Department's equipment. Water pressures are not a problem and all of the new areas have fire hydrants.

The trucks, owned by the BIA, are stationed in two of the Forestry Department's bays.

There are no future plans for the department (BIA Crow Agency, Plant Manager, personal communication, August 21, 1975).

(3) Lodge Grass

The town has a volunteer fire department with 15 men and a class nine rating. This rating is several years old and may not reflect current conditions. The department has a 1942 pumper truck with 500 gpm pumping capacity. The town would like to get a new truck with greater pumping capacities, and the state has recommended it have at least a 750 gpm pumper. Through the Civil Defense Office, the town has also acquired a 6' x 6' army surplus truck which has a 1200 gallon tank with approximately 60 gpm pumping capacity. The truck is also used for rural fires. Assistance may also be obtained from the Crow Reservation. The water is supplied by city fire hydrants and there are no problems with supplies or pressures. At present one truck is housed in the Fire Station at City Hall and one is in the city garage. It is hoped that a new building will be acquired which will house the police, fire, ambulance, and city offices. Tentative plans for the building have been drawn up and various funding sources are being examined (City Clerk, personal communication, August, 1975).

f. Health facilities

(1) Hardin

Big Horn County Memorial Hospital and Nursing Home was built in 1959 and remodeled in 1973-74; the latter involved updating and expanding the emergency room and the nursing home. The hospital, which had 2,398 in-patient days in 1974, has 16 beds, and the nusing home has 34 beds and is fully occupied (Hospital Administrator, Big Horn County Memorial Hospital, personal communication, August 15, 1975). A doctor and a medex, four full-time and two part-time registered nurses (RN), a licensed practical nurse (LPN), four aides, and two medical technologists staff the hospital. In addition, it employs a consultant pharmacist five days a week and contracts a nurse-anethesist for one day each week and at other times as needed. The hospital and its facilities are in good condition; services now provided by the hospital are adequate and are continually being upgraded. However, the staff estimates that 50 percent of their potential patients go elsewhere due to the hospital's shortage of doctors (M.D., Big Horn County Memorial Hospital, personal communication, July 30, 1975). The hospital administrator hopes to hire another doctor this fall which may increase the hospital's usage rate.

The nursing home is in adequate condition. It is staffed by a RN, three LPN's, seven aides, a recreational therapist and on a consulting basis, an occupational therapist and a pharmacist.

In addition to the hospital and nursing home, there is a clinic equipped to accommodate four doctors, two with independent practices. At present, the clinic is staffed by the doctor at the hospital. There are no plans for expansion of the health facilities, although the hospital administrator would like to increase the medical staff.

The private nursing home in Hardin has 22 beds and 19 residents. It is staffed by one LPN, four full-time nursing aides, five part-time nursing aides, a housekeeper, a cook, and the administrator. At this time there are no plans for expansion (Male Nurse, Mt. View Rest Home, Hardin, personal communication, September, 1975).

Dental services are offered by a private dentist who has an office in Hardin. Optometry services are offered by two private optometrists from Billings who visit Hardin once a week (Secretary, Optometrists Office personal communication, August, 1975).

Ambulance service for the county is provided through the Civil Defense Office. There are four ambulances in fair to good conditions, and plans have been made to replace the 1950 model; the other three are 1961, 1968, and 1972 models. With the exception of one in Lodge Grass, the ambulances are stationed in Hardin and available for calls throughout the area. There are two full-time and 14 part-time drivers, all of whom either have had Emergency Medical Training or are RN's. The state is in the process of determining the qualifications for providing medical assistance in the field, and the Civil Defense Office plans to provide additional training for drivers when this new program has been delineated (Civil Defense Director, Big Horn County, personal communication, August, 1975).

(2) Crow Agency

The hospital at Crow Agency which is run by Indian Health Service serves about 10,000 people of the Crow and Northern Cheyenne Reservations, but any Indian in need may use the facilities. The hospital has 34 beds. In 1974, there were an estimated 19-21 in-patients per day or approximately 7,300 per year, and there were 24,000-26,000 out-patient days that year. The doctors delivered about 150 babies during the year (Slaughter, Hospital Director, personal communication, August 22, 1975).

There are five staff physicians at the hospital. The hospital's doctors are obtained through civil service and through the U.S. Public Service Commission. Doctors who are in the Public Service Commission generally join for two years so the turnover does cause periodic changes in the hospital staff's component of skills. In addition to civil service doctors on the staff, there is presently a surgeon, a general practitioner, and a recent graduate who has just completed his internship. Other staff members include a Tresage Nurse, eleven Registered Nurses (RN) (three are administrative), nine clinical nurses, seven Licensed Practical Nurses (LPN), several community health representatives, three lab technicians, two X-ray technicians, two dentists, six dental assistants, a medical records librarian and four people who work in medical records. The hospital has contracts with specialists for work as needed on a consulting basis. In addition, there are seven on the kitchen staff and five on the buildings and grounds staff; the administrative staff has five in the main office including the Hospital Director and the Administrative Officer. This yields a total hopsital staff of 89.

Facilities and equipment at the hospital are adequate and generally better than average. There is a surgical suite although the type of surgery undertaken depends on the make-up of the medical staff at the time. There is also an out-patient clinic and a 24-hour emergency room with a doctor on call at all times.

The out-patient clinic is staffed on a full-time basis by the tresage nurse, an RN, an LPN, a nursing assistant, and a Community Health Representative.

The physicians at the hospital serve the clinic on a rotating basis and there are generally two present at all times. The clinic is presently experimenting with two new programs. The tresage nurse has been given additional training so that under a doctor's supervision, she may handle a broader range of problems. Community Health Representatives are Indians that have at least a high school degree and who assist the staff with patients. Because of these Representatives, the hospital staff feels that it has been successful in reducing misunderstandings and improving communication with the patients (Pease, Community Health Director, personal communication, August 21, 1975).

Future plans call for an additional wing to be added to the hospital; the addition was planned for this year but it has not yet been funded by Congress. The tribe also needs improved coordinations between various groups dealing with alcohol problems, a public health service for the reservation; an ambulance; better sanitary facilities with enforceable regulations governing sanitation; and, most importantly, an adequate nursing home facility on the reservation.

(3) Lodge Grass

There are no health facilities in Lodge Grass. An ambulance, however, has been stationed in Lodge Grass by the Civil Defense Office. The ambulance may answer a call anywhere in the county but its general service area is from about 10 miles north of Lodge Grass south to the state line. Patients are generally taken to the hospital in Hardin or to the one at Crow Agency.

g. Law enforcement

(1) Hardin

The Hardin Police Department, which is responsible for normal police duties as well as animal control, serves approximately 3,000 people. In addition, the Department operates a base dispatch office in the county that handles city police calls and all noon hour and nighttime calls for the county sheriff and ambulance service. The Department has seven men including the Chief and hopes to acquire another this fall. He is presently taking the basic law enforcement training program.

Ideally, the department would like to have nine men: a chief, an assistant, and seven officers. The remaining staff consists of a court clerk, two full-time dispatchers and five part-time dispatchers. The force has two patrol cars, 1971 and 1973 models, and plans to acquire another car. The office is fairly new and in good condition but somewhat small, having about 150-200 square feet.

The 30-bed jail has five cells, one of which is for women. It does not meet state standards, but although lack of funds precludes major improvements, some minor changes to improve compliance are in progress. The jail does not have a separate staff (Police Chief, Hardin, Montana, personal communication, August, 1975).

(2) Crow Reservation

Non-Indians on the reservation may be subject to the jurisdiction of the County Sheriff, the State of Montana, or federal authorities, depending upon the circumstances of the offense.

The Tribal police department is staffed by the police chief, nine policemen, one policewoman, and two criminal investigation officers. The chief and the two criminal investigation men are federal officers. Policemen are assigned to each of the six districts; two of the men are stationed in Lodge Grass, one is in St. Xavier, and one is in Pryor. The others work in the Crow Agency office. In addition to the police staff there are six dispatchers and three jailers.

The police department has four 1975 patrol cars, one 1973 patrol car, and one 1972 emergency van. All of the present cars are in good condition and four more cars have been ordered.

The police department's office in Crow Agency is new and consists of a radio room and three offices. The Court House and Detoxification Center are also housed in the building. A trailer houses the department in Pryor but the men work out of their homes in St. Xavier and Lodge Grass.

The jail in Crow Agency is new and one of the best in the state. There are two cells, two tanks, a kitchen, and a dining area. Two cells are regular holding cells with 8 bunks in the one for men and 4 bunks in the one for women. The other two cells are "drunk tanks"; the larger cell is designed to hold approximately 20 men and the smaller cell to hold about 10 women.

There are tentative plans for a Trustee's Dormitory. The police chief would like to increase his staff to 12 men in addition to the chief and an assistant chief; however, one major problem involved in increasing the staff and stationing the men throughout the reservation is the lack of housing (Police Chief, Crow Reservation, personal communication, August 21, 1975).

(3) Lodge Grass

The town has one full-time policeman who works out of his home. He has a radio-equipped 1968 model patrol car. The county sheriff's office has been authorized to hire another deputy who will be stationed in Lodge Grass in October, 1975. The city and county offices have jurisdiction over the non-Indian population in the area. Indians fall under the jurisdiction of the Crow Tribal Authority which has offices in Lodge Grass with two policemen. Presently, there is no office space for the police.

The jail is located at City Hall. It has two cells, one of which holds four prisoners and the other holds one. The smaller cell is generally used for detaining female or juvenile prisoners. Female prisoners are only held until they can be transferred to a jail which meets special requirements for holding female prisoners. The jail in Lodge Grass does not meet state standards because it lacks bathing facilities and is located in the basement.

The town would like a new building to house the police, fire, ambulance, and city offices. There are tentative plans for the building and the town is examining alternative funding sources. If it is built, there will be room in the present City Hall to move the jail upstairs. If that occurs, the city would remodel to comply with state standards (City Clerk, personal communication, August, 1975).

h. Schools

Table 20 gives data on the individual schools in Big Horn County. The schools are either small community or rural schools with the exception of those in Crow Agency, Lodge Grass, and Hardin, and, as may be noted by a glance at bus mileages, they, too, serve large rural areas. With the exception of the school at Fort Smith, the schools are either over capacity or nearing capacity. In addition, many schools, particularly those in Lodge Grass, need

Table 20. -- Big Horn County Schools (compiled by Mountain West Research, 1975)

District	School	Grades	Enrollment 74-75	Classrooms/Capacity	Acreage	Condition	# Teachers	Other Staff	# Buses Total Miles
Elementary									
1	Decker	1-8	15	1 w/basement/18		Adequate, older school	1		1 small
2	Pryor	K-8	75	7 (also gym, lunch room, kitchen, and office)/150*		Adequate, brick, 10 years old	5	probably will have a few aides	1/856
16	Community	1-6	32	2 and large multi purpose room/40		Adequate, about 8 years old	2	hope to get aide	1/90
17H	Hardin Primary	K-3	302	17/30	19**	Adequate	17**	Principal-6	16/1357**
17H	Hardin Intermediate	4-6	299	12/280		Adequate	16	Nurse-1 psychologist-1	
17H	Crow Agency	K-6	233	14/225	10	Adequate	15	Guidance-4 speech-2 library-2	16/1357**
17H	Fort Smith	K-6	62	6/120	5	Good	6		16/1357**
17K	Big Bend--(Kirby)	1-8	18	1!/20		Adequate	1		1/90
27	Corral Creek	1-8	7	1-room trailer/18		Good	1		No bus
27	Lodge Grass	K-8	230	/190		Adequate	22	1 aide	5/200**
29	Wyola	K-8	100	4 and 2 portable units/130*		Adequate, 19 years old	8 1/2	Probably 12 bilingual aides	3/138
Junior High									
17H	Hardin	7-8	283	13/225	19**	Inadequate	15**	Principal-6 nurse-1 psychologist-1, guidance-4 speech-2, library-2	16/1357**

remodeling or replacement and enlargement. All the schools have enough teachers to maintain recommended class sizes although some schools would like to acquire additional aides.

i. Recreation facilities

(1) Hardin

The city has three parks. South Park, which covers one city block has a playground, three horseshoe pits, a wading pool, a basketball court, a storage house, and two restrooms. One section of the park is burned so that in winter it may be flooded for an iceskating rink. Center Park, a pleasant place with a number of large old trees, also covers one city block and has playground equipment, picnic tables, and two restrooms. Wilson Park only has one-quarter block of land; however, the town is trying to acquire another quarter block. At present the park is undeveloped, but the high school art class has been working on possible plans for development.

The town also has a fairly new pool in good condition, a bath house, and two tennis courts (Recreation Director, Hardin, personal communication, August, 1975). Contracts have been let for an additional three courts, funded jointly by the schools, the county, the town, Westmoreland Resources, and individual residents. The residents also have access to many of the facilities at the schools. Several recreational programs are offered including an arts and crafts class, tennis and baton twirling instruction, and a variety of baseball, softball, and bowling leagues (Director of Program Research and Development, Big Horn County, August, 1975). Privately owned facilities include a bowling alley, a 9-hole golf course, a theatre, and drive-in movie (Hardin Herald, 1975 Guide to Big Horn County, p. 35).

(2) Crow Agency

Recreation facilities at Crow Agency consists of three parks with trees and picnic facilities, a large gym with dressing rooms and showers, a grandstand and arena area, and the Tribal Council meeting hall.

The recreational programs that the tribe sponsors include youth rodeos each year, six Little League teams, and eight Little Guys Basketball teams. There is no permanent recreation staff and much of the work is done by non-profit organizations. Several members of the tribe would like to see a swimming pool built but this will depend on the tribe's ability to raise matching funds for the construction costs. The tribe also operates an educational and recreational Youth Camp at Black Canyon which has been a great success.

(3) Lodge Grass

Lodge Grass has a three-acre park located along the river in addition to the recreation facilities at the school, which include a playground, football, and softball fields, and a play field (Lodge Grass, Montana School Districts 27 & 2, April, 1974). There are no organized recreation programs sponsored by the town or volunteer organizations nor are there any private recreation facilities. There is a Senior Citizens' Club, however.

6. Archaeological resources

Tracts II and III have yielded an abundance of artifacts, indicative of the presence of prehistoric man. Subsurface cultural deposits or evidence of permanent structures are lacking, however, as the people who ventured into the lands were essentially nomadic. (Fredlund, 1975).

Archaeologic sites were most commonly found on the tablelands and terraces at elevations of 3500-3600 feet. At these levels water (springs) and clinker for tool making were available. Higher elevations were also preferred in that they reduced the chances of surprise attack by enemies.

Fifty-three open occupation sites were found in Tracts II and III (Fredlund, 1975). These apparently were temporary hunting camp areas as scraping and cutting tools were found, occasionally over areas several hundred meters across. By contrast, stone rings sites (tipi rings), seven of which were found, were all accompanied by much fewer flaked tools and chips. The tipi rings consist of stones placed in circles three to five meters across, and occasionally containing a stone hearth. Other archaeological remnants in the two tracts include observation sites, quarry sites, two rock art sites, a rock cave and a chipping station.

Within the proposed mine area (Section 36, T.1N, R.37E.) two archaeological sites were found, both of which were camp areas. Abundant flakes and good cores were found at both of the sites, one of which, located along the rim of a ponderosa covered ridge, was apparently extensively used. This site lies west of the proposed active mining area.

The other site, which would be destroyed by the mining, was apparently a short-term camp and lookout point.

7. Historical resources

Westmoreland Resources (1975c) reports that the history of the Sarpy Creek area prior to homesteading is very sketchy. With few exceptions, records are lacking, and there is some confusion over the location of historic sites. The following description is herein directly quoted from Westmoreland Resources report (1975c).

> One early use of the area involved large-scale cattle ranching. The Kendrick Cattle Company, based on Tullock Creek, utilized lands in the Tracts II and III area for winter range, probably beginning soon after the cession of Crow Tribal holdings along the northern border of the reservation.
>
> In 1904, a congressional act ratifying an agreement with the Crow Tribe ceded the northern part of the reservation for settlement by homesteaders. Indians living on these lands were given the choice of retaining individual lands and receiving allotments for them, or of moving to the reservation proper and receiving compensation for the land and any improvements.

The July 18, 1912 issue of the Hysham Echo reported that the Sarpy Creek area had been opened up for settlement. Some people like John and Leonard Luther had come there at least a year earlier. The earliest patent date for any of the properties in the study area is 1914.

From 1907-1943, Sarpy had its own post office. In the latter year the post office was moved to McRea, where it survived for another decade.

Big Horn County was organized January 20, 1913. As a result of a Fall hunting trip by editor Sherman of the Hysham Echo, there is a good description of the people and countryside in the Sarpy area for that year: Sherman observed that the chief industry was stock raising, chiefly horses and cattle, and that most ranch buildings were of the log type (still much in evidence at various sites in the primary study area).

He also noted that although farming was relatively unimportant, there were numerous small fields of oats and corn. This, he thought, indicated the relative richness of the land, which that summer had yielded a rancher at the mouth of the East Fork some 50 bushels of corn to the acre, and another from North Beaver the same in oats. It was the writer's opinion that winter wheat and small grain farming could become an attractive enterprise if it were not for the tremendous distance to a suitable market--an observation which was later borne out when improved transporation and high wartime prices encouraged many Sarpy Creek residents to raise these crops.

Most homesteading in the primary study area occurred during the 1920's in a poor economic climate. When many of these latecomers failed during the droughts of the 1930's, the established families were able to acquire more than their original homestead lands. It was at this time that representatives of the Government tried to encourage all residents to move to the moister climates of the Pacific Northwest; however, many settlers like Bud Redding elected to stay. It is probably significant that most of those who remained had come to the area prior to the 1920's; they, in short, had chosen the area on its merits, and not simply because it was some of the last free land available.

From the 1930's to the present, the consolidation of holdings by individuals has continued. Coupled with modern farming and ranching methods and better transportation, this process has brought the primary study area to the relative prosperity it has enjoyed in recent years.

III. Environmental Impacts

A. Physical Environment

1. Topography and geology

Since state law requires reclamation slopes no steeper than 5:1, any existing steep slopes (such as scoria buttes) cannot be duplicated in the reclamation process.

In areas underlain by Robinson coal only, mining would remove some 20 feet of the stratigraphic column. In areas where the Rosebud-McKay did not burn, about 50 feet of the column would be removed. The void created by such coal removal would to a great measure be compensated for by the swell factor of the spoils. Such swelling typically accounts for an increase in overburden volume of 25-30 percent. This may, however, represent a temporary condition as compaction of spoil areas subsequently occurs as a result of settling and weathering and as a result of blasting at concurrent mine disturbance areas.

2. Climate and air quality

Surface mining generates great volumes of dust from blasting, removal and disposal of overburden, extraction of coal, and traffic on haul roads. Much of this dust is transported downwind from the mine site. Fugitive dust has the potential for dangerously obscuring vision on haul roads and endangering the health of mining personnel. Despite the fact that tanker trucks would regularly water haul roads, some dust emissions from traffic movement in the proposed mine area would occur.

Coal dust is generated at several areas within the mining operation, most prevalently at the coal loadout area (tipple) and at coal blasting sites. Also, because the coal loaded onto unit-trains is uncovered, some coal dust loss occurs during transport. Such loss is apparent from the coal accumulation beside the tracks. Because Westmoreland's anticipated coal production from the Absaloka mine will increase above that currently being produced (see page 7) and because mining in Section 36 is an integral part of Westmoreland's long-range production schedule, coal dust emission levels at the Absaloka mine would remain the same or increase should their proposed mining plan for Section 36 be approved.

The U.S. Geological Survey (1976) reports that:

> *** Accurate estimates of dust loading to the atmosphere as result of these activities cannot be made since definitive data on many of the factors involved are not available and/or are highly variable, e.g., soil types and moisture content, length of material exposure, ability to reclaim disturbed areas and micro-climate data. It should also be recognized that the indirect effect of wind erosion on disturbed materials contributes significantly to dust loading of the atmosphere, and that other sources of fugitive dust, such as vehicular traffic on county and private roads and agricultural activities, are present in the area. Settled particulates (dustfall) averaged approximately 33 tons/mile^2/month adjacent to the present mine site during late July to late August, 1975, and only about 4/tons/mile^2/month from late April to late May, 1975. However, dustfall at a Tract II site removed from and upwind of the mine operation was 120 tons/mile^2/month during the July-August period (Data are not available at this location for the April-May period). ****
>
> *** The large majority of fugitive dust created as result of the mining activities will settle out within a relatively short distance of its source. Based on results of recent studies, approximately 80 percent of fugitive dust created

> by tracked-vehicles settles out within a few hundred yards of its source (Viletto and Ohman, 1972). For dust particles less than two microns in diameter travel distance is much greater and they may be carried by air currents for several miles or further.****

Other sources of pollution include: particulates and gaseous emissions from machinery and trucks operating at the mine and from the unit-train transport of coal over the spur line and indirect source emissions from motor vehicles traveling to and from the mine site (U.S. Geological Survey, Montana Dept. of State Lands, 1976).

Atmospheric pollutants commonly associated with dust and gaseous emission sources include particulates, carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_X) and suflur oxides (SO_X). The U.S. Geological Survey (1976) reports that:

> Emission rates of various effluents from light-duty gasoline-powered trucks, and heavy duty diesel-powered gasoline-powered construction equipment have been determined by the U.S. EPA (1976). Based on these emission rates and on the numbers of major equipment required, it is estimated that approximately 50 grams per second of nitrogen oxides (the most abundant gaseous emission by far from heavy-duty diesel-powered vehicles) would be emitted to the atmosphere at a production rate of 10 million tons per year. This amount is not considered to result in a serious adverse impact on the air quality of the site vicinity, because of numerous individual sources which are spread out over several thousand acres.

Impacts to the climate of the Sarpy Creek area, should Westmoreland's proposed mining plan be approved, would be negligible.

3. Soils and overburden

The proposed mining plan for Section 36, T.1N, R.37E would result in the disturbance or mixing of the topsoil on approximately 250 acres (see figure 2). This disturbance would alter the existing climate-soil-plant relationships. Moreover, off-road vehicle use might seriously disturb soils in areas adjacent to the mine.

As required by the Montana Strip and Underground Reclamation Act, topsoil must be removed from areas disturbed as a result of mining and disposal of spoil materials or as a result of related activities such as construction of roads and water-diversion systems.

Topsoil salvage occurs before overburden is stripped. Topsoil stockpiles must be protected from erosion. Scrapers are utilized in the salvage process with up to about six feet of material being removed.

Impacts to the soil within the proposed mine area include:

a. Mixing of soil horizons

Original soil profiles would be disrupted by the mining process, producing generally unfavorable changes in their physical, chemical, and biological characteristics.

In eastern Montana soils the B-horizon is commonly absent and the A-horizon is usually very thin, about 6 inches being representative. The strip-mining process mixes the organic-rich A-horizon with the much thicker C-horizon, so that most of the nutrients and native seeds locate below the zone of seedling germination. Accordingly, mechanical seeding is needed for revegetation.

Overburden mixing also occurs during the mining operation. Such mixing is a function of numerous factors including: thickness of individual horizons, size of mine area, number of lifts and amount of overburden rehandling. When overburden is removed by scrapers, profiles are inverted with the strata closest to the coal seam being placed nearest the surface of the spoils.

b. Loss of soil nutrients through leaching

Another undesirable effect of the topsoil salvage process is the loss of nutrients through leaching. The extent to which such leaching occurs is highly variable; probably occurring to some extent in all cases, and to the greatest extent in small topsoil stockpiles, where the ratio of surface area to volume is large. Boron and nitrates are two nutrients especially vulnerable to such leaching.

c. Effects of weathering

The depth of weathering in regraded spoils is usually approximately equal to the depth to which winter freezing occurs. This depth is normally about six feet in undisturbed material and may possibly be deeper in spoils having greater pore space. Such weathering releases elements which had been bound in clay minerals, organic complexes, and other inorganic compounds. At present, data on the effects of having such material within the rooting zones of vegetation are lacking, but it is apparent that any such effects may not occur for many years. As weathering proceeds, the ratio of surface area to volume of consolidated (but weathering) overburden will increase so that the rate of release of elements will increase exponentially with time. Elements such as boron, which is essential for plant growth but is also toxic in excessive amounts, could then pass from the nutrient to the toxicant stage years after mining ceases.

d. Changes in soil water movement

Element mobility is complicated by soil water movement. While commonly assumed that soil moisture movement is always downward, such is not necessarily the case. In the Absaloka mine vicinity, ground water recharge is from a topographically higher area than the mine site. If the aquifers are confined, their destruction and replacement by an unconfined situation (spoils) could conceivably lead to reestablished groundwater levels close to the surface with upward movement of elements. Capillary action will account for further upward movement of soil water. Capillary rise in silts ranges between 3 and 30 feet (Scott and Schoustra, 1968). At present, the hydrological characteristics of the Westmoreland overburden cannot be predicted.

4. Hydrology

a. Surface water

(1) Springs

A spring (no. 237 on fig. 6) that has been developed will be physically removed should the proposed mining plan for Section 36, T.1N., R.37E. be approved. The spring has provided adequate high quality water for stock use over the past 50 years (personal communication, Mrs. Vella Redding, Sarpy Creek lessee; see also the memorandum from Mike Bishop in Appendix C). Dames and Moore (Westmoreland Resources

1975d) estimates the flow from this spring to be less than .1 gallon per minute (g.p.m.); recent estimates by DSL personnel however, indicate groundwater flow at the spring to be 3 g.p.m.

A spring designated as number 238 (figure 6) would also be destroyed should Westmoreland's proposed mining plan for Section 36 be approved. This spring has not been improved for several years and looks like a seep with very little surface flow. Additional seeps that are presently located along the lower coulee bottom (as well as the productive vegetation communities associated with them) would also be lost as a result of the proposed plan of mining.

As mining intersects the structural trough in Section 36 ground water gradients will increase adjacent to the mine pit. The increased gradients will cause a lowering of ground water storage in the trough, resulting in a retreat of the ground water divide that corresponds to the topographic divide between Sarpy Creek and the East Fork of Sarpy Creek. Lowered ground water levels may result in a loss of spring 277. The relationship of springs to the northeast of Section 36 to the ground water storage area is less obvious and is not clearly understood. Impacts resulting from mining in Section 36 will be less pronounced on the springs to the northeast due to their greater distance from the structural feature (refer to Appendix I and J).

(2) Impoundments

Impoundments used to settle sediments from disturbed areas can initiate erosional sequences in two ways:

1. If sediments are settled out in the impoundment and runoff passes over the dam without its natural sediment load it may accelerate erosion below the structure because of the increased capacity of the sediment-free water to again pick up sediment load.

2. If a dam failure occurred, the major impact would likely be the initiation of down cutting along the coulee bottom. A minor loss of livestock may also result if a dam failure occurred.

In both cases described above, the initiation of an erosional sequence would be dependent on the rate that water was discharged from the structure. Once the vegetation is disturbed along a stable coulee bottom, as in the tributary to Middle Fork Sarpy Creek below the proposed mine area, and erosion is initiated, it could take several years to stabilize the gradients and vegetation in the watercourse.

(3) Water quality and quantity

Surface water quality may deteriorate as a result of: sediment discharge off the disturbed area, blasting residue, pumping from the pit where sulfates may be accumulated, and oil and grease from machinery. A discharge permit should require that analyses for sulfates, nitrite plus, nitrate as total nitrogen, oil, grease, and turbidity be included among the parameters monitored at the discharge point.

Surface waters in the Sarpy Creek area are a combination of runoff, interflow and groundwater. The groundwater contribution to surface flow contains higher dissolved solids concentration than runoff or interflow because of the soluble constituents that are accumulated during the long transport time through the groundwater basin. During periods of rainfall and snowmelt, surface drainage and interflow, which has a short residence time in the groundwater network, contribute rapidly to streamflow. Due to the rapid movement of water to the larger stream courses, the dissolved solids concentration is lower, and a dilution of the lower quality baseflow results.

As mining proceeds, the construction of small headwater dams that are used in the diversion and impoundment network would reduce the peak flows of the larger drainages and induce infiltration to the groundwater system. The impact of this process would be to change the flow characteristics of larger streams to have reduced peak flows, extended greater volume base flows, and a trend for surface water quality to reflect the additions of lower quality groundwater.

As the volume of spoil material increases at the Absaloka mine, increased vertical infiltration of precipitation and snowmelt and the increased rate that groundwater is transmitted through the spoils could slightly alter the flow characteristics and water quality of the larger streams in the area.

b. Groundwater

(1) Primary impacts

As mining progresses in Section 36, T.1N., R.37E. the pit would disrupt groundwater flow that occurs through the joints and fractures of the Rosebud-McKay and Robinson coal seams and the associated more permeable Rosebud-McKay burn zone. The burned scoria zone (clinker) extends over the western and southern portions of Section 36. Groundwater would also be encountered in the sandstones, siltstones and shales of the Rosebud-McKay overburden and interburden between the coal seams.

The impact of penetrating such aquifers in the course of mining would be to decrease water levels or hydrostatic pressures in the disturbed aquifers around the mine because of increased, reversed or interrupted hydraulic gradients. Under certain conditions, when hydrostatic levels decline in disturbed aquifers above, vertical flow can occur from adjacent undisturbed aquifers resulting in a drop in water levels in the lower saturated zone (Van Voast and Hedges, 1975).

The degree of water level decline expected around the proposed mining operation is difficult to predict because the groundwater data collected thus far in the Absaloka mine area may not be applicable to the groundwater situation in Section 36. The geologic strata in Section 36 may have a greater variation in transmissivity because of the jointing or fracturing that may have occurred in the section and because of the presence of the highly permeable Rosebud-McKay burn zone.

There is structural evidence that suggests that a southwest-northeast trending fold or fault passes through Section 36. This feature is represented as a trough that extends through the section (see figure 7 and Appendix J). Stress or movement associated with this fold or fault may cause jointing or fracturing which would in turn have an affect on groundwater flow. If joints or fractures exist in this folded or faulted area it is expected that accelerated groundwater flow could occur through Section 36.

It is not possible to accurately predict the amount of groundwater that would be encountered nor the area that would experience declines in water levels, but because of the conditions described in Section II-A.6., groundwater drop may occur along the structural trough outside the section.[1] As discussed in III (A)(4)(a)(1) groundwater gradients will increase adjaoent to the operation resulting in a decline in water storage in the overburden along the trough. The result could mean a reduction in flow or complete loss of spring 277.

The Rosebud-McKay and Robinson coal aquifers would yield less water into the pit and experience more localized groundwater declines than the hypothetically more conductive zone described above. Data collected thus far for the Westmoreland area depicts only seasonal fluctuations with regard to water levels in observation wells around the existing mine. The slight amount of groundwater that has been encountered in the Absaloka mine pit to date is reflected in the generally stable groundwater levels for the same period in the observation well network which surrounds the mine.

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[1] The zone of depression that would surround the trough would be monitored with a series of wells that are being added to the groundwater monitoring network.

Figure 7 shows the existing mine to be in a structurally high area north of Section 36 which may explain why very little water has been interpreted in the existing pit. This trend may change as mining expands into Section 36 because of the possible variation in transmissivity of geologic materials in the section and the saturated structural low that occurs in the area.

A report has been prepared by Dames and Moore (Appendix E) to predict drawdown effects of the mining operation on various aquifers at different distances from the pit. The report is based on values that were selected to demonstrate maximum effects expected. According to this analyses, the dewatering effect of a mine cut, assuming that each cut would take approximately one year, on the Rosebud-McKay overburden would be to drop water levels less than one foot at a distance of 1,000 feet from the disturbance. Water level declines in other aquifers will be less than the drawdown in the Rosebud-McKay overburden. Any changes in water levels that may occur in monitor wells around the proposed mining area would allow state officials to predict which existing wells would experience drawdowns and thereby prepare to replace water supplies before hardship occurs.

There is no data available to document what areas in the burn zone are saturated so it is not possible to determine the amount of water expected from this area. After the clinker zone initially drains, where saturated, flow from this area would be greatly reduced until local recharge in the form of rainfall or snowmelt passes through the system.

The geologic structure map showing the base of the Rosebud-McKay Coal, the burn line and the outcrop location of the Rosebud-McKay seam (see fig. 7) together with infrared aerial photographs taken by DSL personnel suggests that groundwater is possibly being discharged through the clinker zone into a coulee bottom in the southeast corner of Section 36. Vegetation in this area appears to be subirrigated; an ash bottom type has been delineated at this location on the vegetation community type map for Section 36 (figure 10). The Ash Coulee plant community type includes green ash (_Fraxinus pennsylvanica_), hawthorn (_Crataegus_ spp.) and American plum (_Prunus americana_). These species are designated as streamside vegetation types in Booth and Wright's _Flora of Montana_ (1966), thus supporting the contention that groundwater is subirrigating an otherwise drier coulee bottom site.

Springs 237 and 238 as well as the suggested subirrigated conditions in the southeast corner of Section 36 would be destroyed by Westmoreland's proposed mining plan.

DSL recently received a complaint from Mrs. Ernest Filler concerning the deterioration of the well supplying the family's water. According to the letter, sediment was being passed from the well at intervals that seemed to correspond to blasting at the Westmoreland mine. Inspection of the well by Nick Tudor of Westmoreland Resources resulted in the hypothesis that a faulty well design was probably responsible for the sediment being transported into the domestic water supply. A new well was provided by Westmoreland and was completed in the Robinson Coal. Efforts were being made to document the cause of the deterioration of the Filler well that extended into the sub-Robinson sands; however, the well collapsed after it was abandoned, and such efforts were discontinued. A continuous groundwater level monitoring program is soon to be implemented to help determine if blasting has an effect on the groundwater system in the Sarpy Creek area.

(2) Cumulative impacts

Additional mining in the Tract III area would greatly change the aquifer systems that existed prior to mining. Mining operations would penetrate the separate shallow groundwater zones to the base of the Robinson Coal. After mining, the spoil material that is replaced will not contain any impermeable zones that would separate the individual aquifers as they existed prior to mining. The saturated zone that would form at the base of the pit after backfilling would either form an unconfined watertable aquifer or a slightly confined aquifer in the rubble zones that form at the base of spoil piles. The mixed groundwaters that resaturate

Section 36 + Expansi

the spoil materials should flow along the structural gradients that exist at the base of the Robinson Coal. For this reason, as mining progresses through the region, the post-mining direction of groundwater flow would be slightly altered.

Postmining groundwater quality is extremely difficult to predict but research at this time indicates that spoil water would be significantly more mineralized than premining waters (Van Voast and Hedges, 1975).

There is no indication that mined out areas will act as barriers to groundwater flow. In the Sarpy Creek area where aquifers are very tight, it is highly probable that the unconsolidated spoil materials would be more conductive than premining aquifer zones.

Recharge that passes through the spoil surface would increase the mineralization of the groundwater. Any impounding structures left on the spoil surface will induce recharge, spoil leaching and therefore lower groundwater quality. There are no plans for leaving impoundment structures on the spoil surface.

Springs would result where the saturated zone of the spoil aquifer intersects the ground surface. This would be in the lower valley areas where the base of the Robinson coal outcrops or subcrops to the valley bottom.

It is not possible to accurately predict the level where the saturated zone would be encountered after mining.

B. Biological Environment

1. Vegetation

a. Existing vegetation destroyed

The most dramatic critical impact on the existing vegetation in the proposed mine area would be its destruction by mining. On all areas from which the topsoil is stripped, the vegetation would be totally eliminated. These include: the mining area, areas of highwall reduction and haulroads. In the "associated disturbance" areas (see figure 2), the effects on vegetation would range from total destruction in some areas to relatively minor disturbances in others.

Vegetation diversity, a pattern which reflects differential topographic edaphic, geologic, hydrologic and grazing conditions, may be lost for many years after mining. Whether all the vegetation communities on the proposed mine area would be recreated after mining has occurred is subject to considerable doubt. Examples of difficult to reclaim plant communities in the proposed mine area include:

1. Ponderosa pine and shrub communities on steep shaded north slopes. Regraded slopes must be gentle in order to be stable. The gentler regraded slopes will probably not offer the shade and subsequent moister environment present prior to mining. In western Montana, Ponderosa pine stands near the limits of their moisture requirements have proven difficult to reestablish. Such may be the case in the proposed mine area.

2. Skunkbush sumac and to a certain extent Ponderosa pine appear to rely on thin soils over rocky areas. Rocky areas are presently not reconstructed in reclamation.
3. Ash coulees, shrub thickets and snowberry rely on varying combinations of aspect, slope, overflow, and/or subirrigation. If post-mining topography cannot furnish sufficient shading these plants would require more moisture if they are to survive. If the moisture in the drainages are comparable to present amounts, remnants of these communities may be established along drainages after mining.

All of these communities are important to wildlife for food and cover.

There is a question as to what kind of soil moisture regime will result on disturbed soils. The texture of the subsoil after mining may have changed, thus eliminating or altering the competitive advantage of a species. For example, a deep rooted plant may no longer be able to extract moisture from the post mining subsoil. This impact would obviously vary with the overburden characteristics and method of mining, and in many instances may not apply.

The impacts of the mining process, particularly topsoil storage, on soil micro flora and fauna is yet to be determined. Many plants have shown a dependency on mycorrhizal fungi. Destruction or a drastic reduction of these fungi by the mining process may eliminate certain plant species.

Vegetative diversity on Section 36 may never attain the level the area had prior to mining. The southern half of the proposed mine area is highly dissected. As mentioned previously, the character of the area may be altered to the point of eliminating community types. There is evidence that an area once disturbed requires a long period of time to recover to its original diversity.

b. Impacts on grazing and agriculture

Portions of Sections 35 and 36, T.1N., R.37E. that are fenced by Westmoreland would be unavailable for grazing use for the project's life. Such acreage should amount to a maximum of approximately 500 acres at any one time. Undisturbed vegetation within the proposed mine boundary, much of which is overgrazed today, would benefit, however, from the exclusion of domestic grazing animals for the life of the project. No agricultural fields (i.e., small grains, alfalfa) exist within Section 36.

c. Effects of dust on vegetation

Soil and coal dust (air-borne particulates) may influence the undisturbed or reclaimed vegetation in the Sarpy Creek area, (dust sources are discussed in section II. A. 5.).

Dust impacts can be separated into three categories (Montana Department of State Lands, 1976b):

1. Dust on leaf surfaces may decrease the photosynthetic ability of the plant, and may plug stomata preventing gaseous exchange.
2. Dust on the plants may interfere with the digestion of the plant by herbivores.

3. Dust may alter the microclimate surrounding the plant. Airborne dust in sufficient quantities could act as a screen, cutting down light to the plant. Coal dust on or around the plant may have a black body effect.

A yet to be resolved question regarding strip mine reclamation is whether revegetated areas will be able to survive a prolonged drought common to eastern Montana. During such a drought, native communities undergo dramatic shifts in composition, with the more xeric (requiring less moisture) species predominating. Reseeded areas lack such native diversity. Even if drought tolerant species are seeded they may be held back by more mesic species in the original stand, and may not be able to take over under drought conditions. This question will ultimately be answered only by more information on the effects of a sustained drought on "reclaimed areas".

2. Wildlife

The range of possible impacts to wildlife from Westmoreland's proposed mine expansion into Section 36, T.1N., R.37E. include:

(1) permanent loss of wildlife habitat and a permanent decline in local wildlife numbers because of (1) inability or failure to identify important habitats or habitat needs prior to mining, or (2) failure to adequately reestablish premining habitat types after mining.

(2) temporary loss of wildlife habitat and/or a depression of local wildlife members because of increased noise, increased human activity, and actual mining disturbance, and

(3) maintained or possibly increased pre-mining wildlife populations because of successful identification, reestablishment and/or improvement of wildlife habitat within the mining area.

Though much effort is being expended to understand wildlife and wildlife habitat in potential mining areas, considerably more information is needed to accurately determine which of the possible impacts listed above would occur should a mining plan be approved for Section 36, T.1N., R.37E. Identification of all habitat needs for a species is difficult if not impossible. It is doubtful, however, that all wildlife populations utilizing Section 36 could be maintained or increased without increased emphasis and subsequent success in reclaiming such lands to wildlife habitat.

As discussed in Section II. B. 2., the proposed mine areas contain considerable diversity of wildlife habitat. Unfortunately, however, successful reclamation for such habitats as the skunkbush shrubs on steep-south facing slopes, scoria outcrops, ponderosa pine, bunch grass, and creek bottom vegetation has not been demonstrated at the Absaloka mine or elsewhere in southeastern Montana. Accordingly, the most obvious impacts of the proposed mining plan include the destruction by mining or spoiling of these habitats.

Such habitats are concentrated in that portion of the proposed mine area to the south or west of the Rosebud-McKay burn line (figure 2). Game animals utilizing these areas include mule deer, Merriams turkey, and sharp-tailed grouse.

The Sarpy Creek Timber Sale, which is located on the same Section 36, involves harvesting all merchantable trees on approximately 165 acres. The only tree species involved is Ponderosa pine which is expected to yield an estimated 417,390 board feet.

The sole reason for the timber sale is to accomodate coal mining activity and salvage the merchantable timber within the strip mine area.

In spring of 1975, the Montana Department of Natural Resources and Conservation prepared a Preliminary Environmental Review (PER) for the proposed timber sale. The PER assessed the environmental impact on vegetation to be the following:

> Some disturbance of grass and shrubs can be expected as a result of logging activity. This should be of a very temporary nature, however. This disturbance could have a slightly negative effect on livestock and wildlife forage for a 1-3 year period.
>
> Impact of logging on the timber stand will be severe. All merchantable trees will be removed, accounting for one-half to two-thirds of the total basal area. Essentially all seed trees will be removed, retarding establishment of reproduction. Some release effect can be expected on established young trees, but a recovery period of about twenty years is anticipated.

The PER evaluated the impacts on wildlife as:

> Wildlife habitat will be adversely effected by the severity of cut of the timber sale. A relatively long term reduction in protective cover for big

game, reduction of food and cover for small mammals, and reduction in food and nesting sites for birds can be expected.

Because logging activity will occur in Section 36 only, its overall impacts are expected to be minimal.

Other impacts to wildlife could include (U.S. Geological Survey, Montana Dept. of State Lands, 1976):

1. Increased occurrences of poaching and wildlife-vehicle collisions.
2. Increased possibility for accidental raptor deaths from the construction of power lines. Mining in Section 36 would also slightly reduce the size of hunting area for these large birds.
3. Loss of habitat for many non-game species. During the mining process, several hundred acres of small mammal habitat would be destroyed as a consequence of mining. This would result in a slight temporary decline in the number of small mammals that make up the primary consumer populations. Mining in Section 36 would also temporarily decrease available nesting and feeding areas for many of the resident song and insectivorous birds in the Sarpy Creek area.

C. Human Environment

The proposed Absaloka mine expansion would employ about 50 additional workers, of which approximately 60% would be Crow Indian or Crow related. In addition, some 20 individuals would be temporarily employed during the opening of the scraper pits and erection of the new dragline (personal communication, Ralph Moore). The majority of workers at the Absaloka Mine are from Big Horn County and the Crow Reservation, and this pattern is expected to continue should the proposed mine expansion be approved. At present it appears that the only individual who would have to be brought in from outside the local area is a licensed electrician (personal communication, Ralph Moore).

It should not be assumed, however, that all new individuals employed as a result of the proposed expansion would necessarily be long-time Big Horn County residents. In any area in which industrial expansion is occurring there are individuals who move in and take up local residence in anticipation of finding employment. Mountain West Research, (1975) reported that many individuals in Hardin are essentially indifferent to employment opportunites at the Absaloka Mine. Therefore, any person moving to the area for the purpose of finding employment stands a fair chance of success.

The effects of local population growth on recreation resources is expected to be minimal because most new jobs created by the mine expansion will be filled from the local labor force.

Some of the new employees hired by Westmoreland would undoubtedly move to Hardin resulting in additional stress being placed on Hardin's housing availability and school enrollment. Such services are both currently being improved however; housing by new construction and schools by the passage in November, 1976 of a school bond issue. (see Section IV C. for further discussion).

If the present pattern continues, most of the new Crow employees would probably not relocate. Westmoreland helps moderate population influx to Hardin or other areas near the Absaloka mine by compensating employees for their travel expenses.

The Crow tribe as a whole would not receive royalties from the mining of Section 36, T.1N., R.37E., as the coal in Section 36 is owned by the State of Montana. However, the high salaries received by most of the mine employees (about $21,000) would certainly provide cash inflow into local communities. Thirty new Crow employees would result in an increase in annual Indian payroll of approximately $600,000. It may be suggested that in light of the poor housing situation on the Reservation, a sizeable proportion of this payroll will go into housing construction and improvements.

For the local residents of Tract III, mine expansions would comprise a further erosion of their existing way of life. Traffic on Route 384, which still remains unpaved in the vicinity of the mine, would increase, and such an increase would result in additional fugitive dust emissions and interference with cattle movement. Blasting would also continue with its apparent effects on the structural integrity of buildings and possible effects on aquifers.

IV. Mitigating or compensating measures

A cooperative agreement has been executed between the Department of the Interior and the State of Montana (DSL) whereby portions of Montana state law that govern reclamation of Federal coal leases disturbed by surface mining in Montana and the administration and enforcement of reclamation laws has been delegated to the State of Montana (DSL). The text of this agreement and the adoption of portions of the Montana state laws were published in the Federal Register on June 13, 1977 under the authority contained in 30 Code of Federal Regulations Part 211.

A. Laws and regulations

Significant state laws and regulations for mitigating impacts at the Absaloka mine include (U.S. Geological Survey, Montana Department of State Lands, 1976):

1. The Montana Strip and Underground Mine Reclamation Act (Chapter 10 of Title 50 R.C.M. 1947) and rules adopted thereunder (subchapter 10 of Chapter 10, Title 26, Montana Administrative Code) and summarized by the Montana Environmental Quality Council (1973) as follows:

> "The Reclamation Act (passed in 1971, amended in 1973, 1974 and 1975) requires that any person intending to remove by strip mining more than 10,000 cubic yards of coal, uranium, and or overburden must obtain a permit from the Department of State Lands.
>
> "Permits are issued for a period of one year and must be renewed annually.[1/] An application for a permit must include a plan for the mining operation and for the reclamation, revegetation, and rehabilitation of the land and water affected

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[1/] permits will be issued for a 5 year period beginning July 1, 1977.

by the mine. The law requires a detailed pre-mining inventory of the natural man-made characteristics of the mining area including vegetation, wildlife, soils overburden, surface and ground water hydrology, ownership patterns, location of all water, oil, and gas wells, roads and utility lines. During the operation of the mine continued water quality, soil and overburden sampling is required.

"Area strip mining, a method of operation which does not produce a bench or fill bench, is required. Furthermore, the mined area must be restored to approximately its original contour and topsoil must be conserved. To insure that the provisions of the permit are carried out, a bond must be filed with the department for an amount determined by the board based on the characteristics of the area to be mined. The bond may be neither less than $200 nor more than $2,500 for each acre or portion of an acre to be mined, provided that the bond equals the estimated amount that would be required for the state to complete work described in the reclamation plan. Return of the bond is contingent on the mine operator's faithful performance in completing the act's requirements. In no case can a bond be released sooner than five years after revegetation.

"In addition to forfeiture of bonds, the department may enforce the law through the suspension of existing permits or in the case of a mine operator who has more than one permit, the denial of permission to mine lands under the other permits. Civil and criminal penalties are provided for in the act, and the right to seek mandamus in district court to compel state officials to perform their duty under the act is granted to all residents of the state."

Upon receipt of a surface-mine permit application, the Department initiates a review of the application for completeness and conformance with provisions of the Reclamation Act and rules adopted thereunder. The Act and promulgated rules contain detailed standards regarding the method of mining, blasting, subsidence stabilization, water control, backfilling, grading, highwall reduction, topsoiling, and for the reclamation of lands affected by the proposed mining operations. As provided for in the Act, the Department has a maximum review period of 240 days within which to reach a decision regarding a permit application; however, the 240 day time span does not begin until all information required by the Act and rules is complete.

To ensure compliance with the Reclamation Act, the Department is required to make such mine inspections and investigations as necessary. The Department can refuse to issue a permit for mining in areas that meet the Act's criteria for selective denial. To minimize detrimental impacts, the Department may conduct studies or encourage others to conduct studies of strip mining and strip-mined land reclamation. Finally, the Act specifies that the Board of Land Commissioners may reclaim strip-mined lands using funds received from bond forfeiture, from the State or Federal government, or from other sources.

2. The Strip Mined Coal Conservation Act (Chapter 14 of Title 50, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 14 of Chapter 10, Title 26, Montana Administrative Code) requires that any person intending to remove more than 10,000 cubic yards of coal or overburden by strip mining must first obtain approval of a strip-mining plan from the Department of State Lands.

The intent of the Coal Conservation Act is to prevent waste of marketable coal. Marketable coal is defined as "strippable coal that is economically feasible to mine and is fit for sale in the usual course of trade."

The mining plans, once approved, are effective for one year from the date of approval. A mining plan must include provisions for the removal and utilization of strippable and marketable coal located within the area to be mined. The department may require an operator to submit, in addition to the mining plan, any information it deems necessary to determine whether waste would occur. Moreover, the department may make any inspections and investigations it deems necessary for review of a plan.

If a strip-mining plan is disapproved under the Coal Conservation Act, the operator has the right of appeal and a hearing before the Board of Land Commissioners. Civil penalties may be imposed on those who fail to obtain an approved strip-mining plan prior to mining or on those who do not comply with the terms of an approved plan.

3. Section 81-103 of the Montana Codes R.C.M. 1947 requires that the Board of Land Commissioners manage State-owned lands under the multiple use concept as follows:

> "***the management of all the various resources of the state lands so that they are utilized in that combination best meeting the needs of the people and the beneficiaries of the trust, making the most judicious use of the

> land for some or all of those resources *** without impairment of the productivity of the land, with consideration being given to the relative values of the various resources."

4. Section 81-501 of the Montana Codes R.C.M. 1947 authorizes the State Board of Land Commissioners to grant coal leases. The Westmoreland lease requires the lessee agree to take such precautions as necessary to minimize soil erosion, water pollution, and damage to range improvements or crops (see Appendix A). The process of mining, handling, and marketing of State coal must prevent, insofar as possible, all waste of coal, and all mining operations must be conducted in a systematic and orderly manner that would not make subsequent mining operations more difficult or expensive. A violation of any of these conditions is grounds for forfeiture of the lease after a hearing before the Board. Every holder of a producing State coal-mining lease must (1) report monthly the amount, price received, and total amount of all sales for the previous month and (2) pay royalties monthly at the rate specified in the lease.

5. Montana's Clean Air Act (Chapter 39 or Title 69, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 1 of Chapter 14, Title 16, Montana Administrative Code) defines air pollution and provides that the Board of Health and Environmental Sciences may prohibit

> "...the construction, installation, alteration, or use of any machine, equipment, device or facility which it finds may directly or indirectly cause or contribute to air pollution or which is intended primarily to prevent or control the emission of air pollutants, unless a permit therefore has been obtained from it."

6. Montana's Water Pollution Control Act (Chapter 48 of Title 69, R.C.M. 1947) and administrative rules adopted thereunder (subchapter 10 of Chapter 14 Title 16, Montana Administrative Code) charges the Department of Health and Environmental Sciences with the responsibility of regulating water quality by administering a permit system.
7. The State Antiquities Act, (Chapter 25 of Title 81, R.C.M. 1947) which is administered by the Board of Land Commissioners, the Montana Historical Society, and the Department of Fish & Game, provides for the registration and protection of historic, prehistoric, archaeologic, paleontologic, scientific, or cultural sites and objects on State lands. It also provides that the Department is authorized to enter into cooperative agreements with private landowners to preserve, mark, maintain, excavate, or otherwise deal with such sites and objects upon such terms as may be agreed upon.
8. The Montana Resource Indeminity Trust Act (Chapter 70 of Title 84, R.C.M. 1947, and rules adopted thereunder (subchapter 14 of Chapter 14, Title 42, Montana Administrative Code) provides for a tax on mineral production (including coal). The taxes

are paid into the resource indemnity trust account. The trust account will be allowed to accumulate until it reaches the amount of one hundred million dollars, at which time the legislature is empowered to appropriate net earnings and all receipts for improvement of the environment and rectifying damages thereto.

9. Coal Severance Tax Act (Chapter 13 of Title 84, R.C.M. 1947) and rules adopted thereunder (subchapter 6 of Chapter 14, Title 42, Montana Administrative Code) imposes a severance tax of up to 30 per cent of the value of coal removed by surface mining methods. The taxes collected are allocated as follows:

> "(1) To the county for such purposes as the governing body of that county may determine from which coal was mined for each calendar year prior to January 1, 1980, three cents (3¢) per ton or four percent (4%) of the severence tax paid on the coal mined in that county, whichever is higher, and for each calendar year following December 31, 1979, three cents (3¢) per ton or three and one-half percent (3 1/2%) of the severance tax paid on the coal mined in that county, whichever is higher.
>
> "(2) Two and one-half percent (2 1/2%) of total collections per year until December 31, 1979, and thereafter four percent (4%) of total collections per year to the earmarked revenue fund, to the credit of the alternative energy research development and demonstration account.
>
> "(3) Twenty-seven and one-half percent (27.5%) of total collections per year, until July 1, 1979, and thereafter thirty-five percent (35%), to the earmarked revenue fund to the credit of the local impact and education trust fund account.

> "(4) For each of the four (4) fiscal years following the effective date of this act ten percent (10%) of total collections per year to the earmarked revenue fund to the credit of the coal area highway improvement account.
>
> "(5) Ten percent (10%) of total collections per year, to the earmarked revenue fund, for state equalization aid to public schools of the state.
>
> "(6) For the period ending December 31, 1979, one percent (1%) of total collections per year to the earmarked revenue fund, to the credit of the county land planning account.
>
> "(7) Two and one-half percent (2 1/2%) of total collections per year to the sinking fund, to the credit of the renewable resource development bond account.
>
> "(8) Two and one-half percent (2 1/2%) of total collections per year through June 30, 1979, of which portion one-half (1/2) shall be allocated to the earmarked revenue fund, for the purpose of acquisition of sites and areas described in section 62-304, subject to legislative appropriations, and one-half (1/2) shall be allocated to the trust and legacy fund, for the purpose of parks acquisition. Income from the fund established in this subsection may be appropriate for the acquistion of sites and areas described in section 62-304.
>
> "(9) To the earmarked revenue fund, such portions of the severance tax as may be authorized by laws enacted in 1975.
>
> "(10) All other revenues from license of severance taxes collected under the provisions of this chapter shall be deposited to the credit of the general fund of the state."

In addition to state laws and regulations, Westmoreland Resources must also comply with all applicable regulations of the Federal government. Federal regulations are discussed in detail in the Final Environmental Statement, Crow Ceded Area Coal Lease Tracts II and III, Westmoreland Resources (U.S. Bureau of Indian Affairs, 1976).

B. Physical Environment

1. Geology

Spoil piles will be regraded to a maximum of 5:1 slope, retopsoiled and seeded. This procedure will reduce the liklihood of significant mass wasting or erosion. After mining is completed, drainage of the tributary to the Middle Fork of Sarpy Creek will be allowed to flow through a constructed drainageway in Section 36, T.1N., R.37E.

2. Air quality

Westmoreland engages in two primary activities to mitigate impacts at their Absaloka Mine:

a. Tank trucks are used to water haul road surfaces, and

b. the company is engaged in an active program to revegetate mining disturbances.

The fact that Westmoreland has violated air quality standards suggests that haul road watering should be increased, and that if possible, haul road lengths should be shortened. However, it is probable that coal dust from the coal processing and loadout area is the prime source of air borne particulate matter in the mine area. The Air Quality Bureau of the Montana Department of Health & Environmental Sciences is interested in the results of air quality monitoring in the area of the Absaloka Mine and has requested that Westmoreland submit monitoring data on a monthly basis (personal communication with David Maughan, Montana Dept. of Health & Environmental Sciences).

Coal is transported from the pit to the processing facility in open haul trucks. At the processing facility, coal is fed into crushers, then by conveyor into the coal storage building, which reduces fugitive dust emission until loadout into unit-trains. Dust control measures incorporating latest technology are included in the design of crushers, conveyers, and loading facilities (U.S. Bureau of Indian Affairs, 1976). Despite this fact however, considerable amounts of coal dust are still released during the dumping and crushing operations, and during the loadout process.

It is not likely that much can be done to reduce dust emissions from overburden and coal stripping operations, however, revegetation of spoils helps reduce wind erosion. In accordance with the Montana Strip and Underground Mine Reclamation Act, spoils would be contained, graded and seeded as soon as practical after mining but no more than two spoil ridges behind the area of active mining.

In addition to producing dust, blasting, when done improperly, can also release carbon monoxide and oxides of nitrogen (rather than pure nitrogen gas) into the atmosphere. There are several conditions which could cause this to happen including: inadequate priming, water in the explosive mixture, insufficient charge diameter, etc. All these conditions can be avoided with proper care. DSL is aware of no such problems at the Westmoreland operations to date.

3. Soils

Westmoreland has agreed to make approximate separation of soil horizons during the stockpiling process. Topsoil would not be rehandled until the soil was redistributed onto graded spoils. If a stockpile is to remain for more than six months, Westmoreland plans to seed it with yellow sweetclover and crested wheatgrass. Barley or wheat would be utilized for more temporary stabilization. In addition, Westmoreland Resources, (1976a) states:

> Topsoil will be replaced on the regraded spoil not more than 90 days before planting. Where possible topsoil will be removed from unmined areas by use of rubber tired scrapers, hauled directly to the placement site and deposited on the recontoured area to a depth of 24 inches.

4. Hydrology

a. Surface water

A small, unnamed tributary to the Middle Fork of Sarpy Creek crosses the proposed mine area. Prior to mine disturbance, a series of impoundments on this coulee would be constructed in an attempt to prevent accelerated sediment movement off the mine area. During the initial mining of Section 36, including the scraper pit and dragline cuts through 5, drainage will be controlled by 4 small impoundments in upland drainageways to the north of the unnamed tributary to the Middle Fork of Sarpy Creek. Two temporary impoundments would be constructed to the east of the highwall side. The primary sediment control pond (#5 or #6) will be constructed prior to cut number 6 in order to prevent sediment or blasting residue from being transported off the project area.

The catchment system is designed to allow runoff at least a 10 year 24 hour storm to be impounded for an adequate period to meet E.P.A. regulations and the conditions of a discharge permit. Under the proposed interim regulations of the new Surface Mining Control and Reclamation Act of 1977 Westmoreland would have to change the design of the impounding structures to allow discharges to meet effluent limitations under conditions of a 25 year 24 hour precipitation event.

Any discharge beyond the final impoundment below the mining area will have to meet the requirements of the Water Quality Bureau in a discharge permit. Surface drainage should not lower the quality of the state waters below the mined area. If a potential pollution problem is revealed in the water quality monitoring program a treatment scheme will be devised to correct the problem.

Impoundments if properly designed can settle out the products of accelerated erosion and discharge runoff at a rate that will not subject the lower undisturbed drainage to increased erosion.

The loss of springs on Section 36 as a stock water source can be replaced with a well to the Sub-Robinson zone and a holding tank. A well has recently been drilled to the Sub-Robinson zone in Section 36. Water quality and well production will be evaluated relative to suitability for a stock water source prior to permit approval. It would be undesirable to construct small dams on the reclaimed surface since these structures would induce groundwater recharge and therefore would promote undesirable leaching of spoil materials.

b. Groundwater

Any loss of groundwater around the Section 36 area can be replaced with a well to the Sub-Robinson zone. This zone has been used in the Tract III area as a domestic water supply. Care should be taken not to induce groundwater recharge by impounding water on the spoil surface because any increase in spoil leaching will deteriorate groundwater quality.

Groundwater flow through the area will be reestablished as described under cumulative impacts.

C. Biological Environment

1. Vegetation

Section 50-1045 of the Reclamation Act Requires that a strip-mine operator must plant those species of legumes, grasses, shrubs and trees "necessary to provide a suitable permanent diverse vetetative cover capable of:

(a) feeding and withstanding grazing pressure from a quantity and mixture of wildlife and livestock at least comparable to that which the land could have sustained prior to the operation;

(b) regenerating under the natural conditions prevailing at the site, including occasional drought, heavy snowfalls, and strong winds; and

(c) preventing soil erosion to the extent achieved prior to the operation."

The present seed mixture used by Westmoreland Resources consists of 10 grasses, 2 forbs, and 1 shrub and is a mixture primarily created to restore mined areas for livestock grazing usage (see revegetation plan in Appendix H). Because of recent overgrazing on Section 36, should reclamation be successful, it is likely that this area would be more productive from a livestock foliage standpoint than it is today. Also, gentle post-mining contours would make it easier to attain an even grazing pressure.

Westmoreland is presently preparing a new seed mixture for use in their revegetation efforts. This mixture consists of a variety of native grasses, forbs, shrubs, and some introduced grasses. With such a highly diverse mixture, individual revegetative species may be better able to establish on areas suited to their individual needs, thus accelerating the formation of comples communities. The actual mixture used will vary from year to year depending on seed availability.[1/]

Westmoreland also plans to obtain nursery plantings of shrubs and trees some of which will have been grown from seed gathered in the Sarpy Creek area. Such species include: skunkbrush (*Rhus triolobata*) golden current (*Ribes aureun*), and Ponderosa pine (*Pinus ponderosa*). Other shrub and tree species may be added to this list in the future. Initially, shrubs and trees will be used in experimental plantings and hopefully would eventually become part of Westmoreland's Reclamation Program.

Westmoreland is presently having some success in regeneration of vegetation from redistributing the upper 12 inches of topsoil immediately after stripping. Several grasses and some important shrubs (rose and snowberry) have shown good revegetation from vegetative parts (rhizomes, root crowns) in the topsoil. Whether or not substantial stands will result remains to be seen.

The long term success of reclamation in eastern Montana is yet to be determined. Only through time will success or failure be proven. The Montana Strip and Underground Mine Reclamation Act allows vegetative bond release five years after initial planting; however since the act was passed only four years ago, no areas are yet eligible for such release.

[1/] By creating a market for native seed, commercial production of such should be stimulated.

2. Wildlife

Timely restoration of habitat lost is the most effective method of mitigating wildlife impacts caused by strip-mining. This effort is facilitated by carefully addressing the needs of local wildlife prior to mining and subsequently by attempting to satisfy such needs through the reclamation process.

Section 50-1045(a) of the Montana Strip and Underground Reclamation Act requires that reclaimed lands ". . . be capable of feeding and withstanding grazing pressure from a quantity and mixture of wildlife and livestock at least comparable to that which the land could have sustained prior to the operations." Due to the maximum 5:1 grading requirements of the Act, however, reclaimed lands may be made more suitable for crop or livestock uses than existed in the pre-mining condition. Such grading could potentially represent a long-term negative impact for many species. Westmoreland's reclamation efforts have, to date, been aimed primarily for livestock grazing usage.

In light of the above, the Department suggests that the following mitigating measures be taken relative to wildlife and wildlife habitat for Westmoreland's proposed mine area:

(1) deletion of mining disturbance in areas where important wildlife use has been identified or where re-creation of such areas through the reclamation effort is doubtful

(2) make the reestablishment of wildlife population numbers in the proposed mine area a specific reclamation goal.

Upon Departmental request, Westmoreland's revised mining plan for Section 36, T.1N., R.37E. deleted from mining-level disturbance areas in the southwest portion of the proposed mine area, which the Department considered of doubtful reclaimability. In addition, the alternate impoundment site (figure 2) proposed by Westmoreland, if chosen, would reduce potential impacts to portions of the important creek bottom vegetation within the section.

To help reestablish wildlife population numbers, Westmoreland might reclaim a portion of Section 36, T.1N., R.37E., specifically as wildlife habitat and manage such areas accordingly. Were successful reclamation to occur over all mined lands, and were such lands to contain game management areas within them, quality of wildlife habitat might equal or surpass that which is currently in existence.

D. Human Environment

1. Social services

Pressures on Hardin's school system resulting from population increase will be mitigated by the recent passage (November, 1976) of a school bond issue. The bond issue, amounting to some two million dollars, provides for a new junior high school, additions to the intermediate school, and remodeling at the high school and the school at Crow Agency (personal communication, Superintendent's office, school district 17-H). In addition, the Montana Coal Severance Tax is presently generating revenues at the Absaloka and other southeastern Montana coal mines. Portions of such monies will be made available to Big Horn County in the following ways: coal area highway development, Local Impact and Education Trust Account, school equalization support, direct payments to the county's general fund, land use planning funds, and park acquisition (Himsl, 1975). As of December 1, 1976, the following severance tax monies have been allocated to Big Horn County (personal communication, Montana Department of Revenue):

Hardin Sewer Lagoon	$ 231,135.00
Hardin Capital Equipment	$ 128,154.76
Lodge Grass Capital Equipment	$ 125,250.00
Lodge Grass Water Line	$ 171,872.28
Hardin Elementary School	$ 2,041,648.00
Hardin High School	$ 1,168,000.00
Total	$ 3,866,060.04

2. Housing

Housing availability in Hardin is either stable or improving slightly and it is unlikely that the approximately 50 new employees resulting from the Absaloka mine expansion would appreciably affect the Hardin housing market. The majority of those hired by Westmoreland would be members of the Crow tribe who already live in or near Hardin.

3. Transportation

An additional eleven miles of secondary route 384 from Hardin to Sarpy Creek are scheduled to be paved during the summer of 1977 (personal communication, Montana Highway Department). This should facilitate access to the Absaloka mine and reduce fugitive dust emissions.

Because the high volume of traffic on highway 384 has been noted to cause significant impacts to the area residents (see Section II. C.), it is suggested that Westmoreland consider operating a bus service between Hardin and the mine coinciding with shift changes.

4. Recreation

At this point, there are no anticipated impacts on recreation facilities that would require proposing mitigating measures. It is believed that present recreation facilities will be able to absorb the minimal increase in use that may occur.

5. Tax revenues

If Section 36 was to be mined, production taxes and royalties would be paid to the state, and possibly would be used for the mitigation of impacts. Approximate total anticipated revenues from Section 36 are:

Royalties	$ 6,125,000
Severence Tax	45,465,000
Gross Proceeds Tax	7,595,000
Resource Indemnity Tax	445,000
	$59,630,000

V. Irreversible and irretrievable commitments of environmental resources

In this draft EIS the phase "irreversible and irretrievable" is considered to be essentially synonymous with "consumed". Resources include not only the materials and labor required to mine the coal but also the natural and cultural values that may be altered as a result of the project implementation.

Approximately 44 million tons of strippable coal underlie the project area. Once mined, the coal is a non-renewable energy source.

In about 241 acres of mined area the existing topography, soil profile and overburden would be irreversibly altered by implementation of the proposed action.

Surface and ground-water resources of Section 36 will in large part not be available for other potential uses during the life of the project. Two springs (no. 237 and 238, figure 6) would be physically removed should the proposed mining plan be approved. Additional seeps that are presently located along the lower coulee bottoms (as well as the productive vegetation communities associated with them) would also be lost as a result of the proposed plan of mining.

The native vegetation communities' diversity and variety may be irreversibly committed upon mining. The elimination by mining of the variety of natural conditions that presently exist can be considered irreversible.

If reclamation is not successful 240 AUM's of grazing will be lost for Section 36.

Until reclamation success becomes more defined, the long-term maintenance of the original productivity of the land is subject to question. This could ultimately mean a decrease in the productivity in the mined areas for an indefinite period for either wildlife or livestock. Wildlife habitats dependent upon unusual conditions or diversity could be permanently lost.

The elimination of sandstone outcroppings and vegetative diversity of original topographic contours is an irreversible commitment of aesthetic resources, as the original visual resource can never be duplicated. The reduction of the quality of the visual resources of Section 36 would not, however, eliminate any outstanding or rare visual resources.

In the strict sense the archaeological excavation or salvage of a cultural resource is an irretrievable commitment. However, the data obtained in salvage are contributions to knowledge which could not be obtained otherwise, and as such produce benefits which offset the commitment.

The energy needed for production of coal for the proposed action is an irretrievable resource and includes diesel fuel for crawler and rubber-tired equipment and electricity for the draglines, shovels, large drilling equipment, coal handling equipment, and transportation energy costs for the Westmoreland coal.

VI. Comparison between short term costs and long term productivity

The most obvious conflict is between the traditional use of the land for wildlife habitat and rangeland grazing and the proposed short term use for surface mining. Westmoreland wants to permit 640 acres for mine expansion, an area which will most likely be fenced for the duration of mining.

If reclamation is successful, the long term use of the land for wildlife habitat and rangeland grazing purposes may be altered but not eliminated. Man made contours will result in microclimatic changes and most likely will affect the post-mining productivity of particular areas. Soil, air and water quality may all be adversely affected on reclaimed areas in the short run.

The surface mined coal will be utilized for electrical generation purposes, providing heat, lights, and other energy requirements. It will also help urban as well as rural power companies to meet SO_x air pollution standards.

Little is known about the effect of surface mining upon subsequent underground mining, however, some feel that the relationship may possibly be negative. Thus surface mining could jeopardize the future removal of coal seams in Section 36 laying below the Robinson.

VII. Description of alternative actions

A. Denial of the permit

Denial of the permit for Section 36 would mean that Westmoreland would continue to mine under their existing permits for Section 25, immediately adjacent to and north of Section 36. The recoverable coal able to be mined under these permits is limited, however, and Westmoreland would soon be required to submit new permit or permit amendment applications in order to meet contract demands. The ultimate result of further permit denials would be the loss of Westmoreland-related employment and the termination of the Absaloka mine as a source of low-sulfur coal. Losses of taxes to the state and royalty revenues to both the Crow Tribe and the state would also occur.

Other potential sources of low-sulfur steam coal would be other Montana or Wyoming strip mines. Contract purchasers could possibly obtain high-sulfur Illinois or Appalachian coal but air pollution control might become a problem. Low-sulfur coals from Illinois and Appalachian are used for metallurgical processing and by utilities.

B. Underground mining

Underground mining is often spoken of as a desirable alternative to strip mining in that disturbance to the land surface overlying the coal is minimal. While this may be true during the life of the operation, subsidence often occurs after mining ceases. Two examples of such subsidence in the Northern Great Plains are to be found in the area between Sheridan, Wyoming and Decker, Montana, and in an area about three miles north of Beulah, North Dakota. In the latter example, overburden ranged from 30 to 140 feet, and only 44% of the available coal was recovered. Strip mining, while totally disruptive in its surface effects, can be regulated until a permanent stabilization of the mined surface is achieved. Assuming that permanent revegetation can be achieved, the only long-term unknown is compaction of spoils. The seriousness of the compaction problem in the Northern Great Plains is yet to be determined.

Other disadvantages to underground mining include higher frequency rates for both fatal and non-fatal accidents, lower coal recovery rates, and higher operating costs which cause an approximately seven fold increase in the sale price as compared to surface mined coal (DSL, 1976a).

C. Contour, auger, and in situ mining

Contour mining is prohibited by the Montana Strip and Underground Mine Reclamation Act.

Auger mining would recover about 10% of the coal resource. This would result in a waste of virgin coal seams because auger mining renders them unsuitable for mining by any other method.

In situ mining, used in the mining of sulfur, potash, and uranium, is a method in which super-heated water or another solvent is pumped into an ore-body and then the resource bearing solution is withdrawn and processed. This method is probably not feasible for coal. There appears to be little technology today to determine whether the coal seams are sufficiently friable to be pumped from the underground as a slurry. No markets for such a product are currently available. Damage to aquifers and other subsurface structures by *in situ* mining is unpredictable.

D. Alteration of mining and/or reclamation plan

Under the Montana Strip and Underground Mine Reclamation Act, the mining and reclamation plan must comply with all aspects of the law before a permit can be granted. Substantial alteration while still allowing surface mining would therefore not change the impact of the operation appreciably.

E. Utilization of other forms of energy

Other fossil fuels such as natural gas and petroleum, are in more limited supply than coal. Oil shales and tar sands are only available on a small scale and are thus not an available alternative at this time.

Nuclear power has encountered technical difficulties in providing adequate safety precautions. Public reaction has also been slowing its development.

Solar, geothermal and wind energy converters are still experimental or pilot plant scale operations. But while such sources show promise, their large scale utilization is still some time in the future.

Hydroelectric generation facilities in this country have utilized almost all available sites. Many hydroelectric dams have had additional power houses built.

VIII. References

Booth, W.E., and J.C. Wright, 1966, Flora of Montana. Montana State University, Bozeman.

Botz, M.K., Sept. 1977, The Hydrological System at Westmoreland's Sarpy Creek Property, A Comparison with the Portions of the Fort Union Coal Region in Montana: Helena, Mt.

Ecological Consulting Service, 1974, Report to: Westmoreland Resources, range condition and production study, Sarpy Creek mining area: Helena, Mt.

Ecological Consulting Service, 1975, Westmoreland Resources Tract III annual monitoring report - wildlife and wildlife habitat: Helena, MT.

Ecological Consulting Service, 1976, Westmoreland Resources, Wildlife monitoring report including habitat diversity and utilization analysis of the major wildlife species on the Tract III study area June 1973-May 1976.

Finch, Thomas, 1974, The use of Montana's coal as an energy resource, a report to the Montana Environmental Quality Council.

Flawn, Peter T., 1970, Environmental geology - Conservation, land-use planning, and resource management, Harper and Row, New York, 313 pp.

Fredlund, 1975, Archaeologic Resources, Environmental baseline - study for Crow Indian coal leases.

Himsl, M., 1975, 1975 Montana Coal Tax; in Proc. Fort Union Coal Conference, Oct. 13-15, 1975, Bismarck, North Dakota, Appendix 10.

Intermountain Planners, Inc., Comprehensive Plan, Big Horn County Planning Board Jurisdictional Area 1974-1975, Billings, Montana: 1974.

Montana Department of Health and Environmental Sciences, 1967, Montana ambient air quality standards, adapted May 7, 1967 by the Montana Board of Health and Environmental Sciences in accordance with Section 69-3909 R.C.M. 1947: Helena, MT.

Montana Department of Natural Resources and Conservation, 1977, Forestry Division, Preliminary environmental review, Sarpy Creek Timber Sale.

Montana Department of State Lands, 1973, Final environmental impact statement, administrative action, proposed Westmoreland Resources' Sarpy Creek Mine - Big Horn County: Helena, MT.

Montana Department of State Lands, 1975a, Addendum to Final environmental impact statement, administrative action, proposed of a strip mining permit for the contribution of Westmoreland Resources' Sarpy Creek Mine in Big Horn County, Montana.

Montana Department of State Lands, 1975b, Preliminary environmental review, proposed approval of an amendment to Westmoreland Resources 1975 mining permit: Helena, MT.

Montana Department of State Lands, 1976a, Final environmental impact statement for the proposed expansion of Western Energy Company's Rosebud Mine in Area B: Helena, MT.

Montana Department of State Lands, 1976b, Preliminary environmental review, proposed approval of an amendment to Westmoreland Resources' 1976 mining permit: Helena, MT.

Montana Environmental Quality Council, 1974, third annual report: Helena, MT.

Mountain West Research, 1975, Socio-economic report, prepared for Westmoreland Resources as part of the environmental baseline studies for Crow Indian coal leases: Billings, MT..

Mueller Engineering, Inc., 1974, Consulting Engineers, Study and report for water systems analysis and improvements, City of Hardin, MT.

Scott, R.F., and J.J. Schoustra, 1968, Soil Mechanics and Engineering, McGraw-Hill, 314 pp.

Thornwaite, C.W., 1948, An approach toward a rational classification of climate, Geograph. Rev., vol. 38, pp. 55-94.

Toole, K.R., 1976, The Rape of the Great Plains, Little, Brown, and Company. Boston, Mass.

U.S. Bureau of Census, 1976a, Special Census of population: Big Horn County, Montana, unpublished.

U.S. Bureau of Census, 1976b, 1974 Census of agriculture, preliminary report: Big Horn County, Montana.

U.S. Bureau of Indian Affairs, 1976, Final environmental statement Crow Ceded Area coal lease, Tracts II and III, Westmoreland Resources: Billings, MT.

U.S. Geological Survey, Montana Department of State Lands, 1976, Draft environmental impact statement, proposed plan of mining and reclamation, East Decker and North Extension Mines, Decker Coal Company, Big Horn County, Montana, 2 vol., 758 pp. & appendices.

U.S. Geological Survey, 1976, Proposed 20-year plan of mining and reclamation, Westmoreland Resources, Tract III, Crow Indian Ceded Area, Montana: Denver, CO.

U.S. Environmental Protection Agency, 1971, National ambient air quality standards, adopted Nov. 25, 1971, in accordance with the Code of Federal Regulations 36 FR, p. 22384: Washington, D.C.

Van Voast, W.A., and R.B. Hedges, 1975, Hydrogeologic Aspects of Existing and Proposed Strip Coal Mines Near Decker Southeastern Montana. Montana Bureau of Mines and Geology open file report 97: Butte, MT.

Westmoreland Resources, 1975a, Environmental baseline studies for Crow Indian coal leases, Geology, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1975b, Environmental baseline studies for Crow Indian coal leases, Soils, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1975c, Environmental baseline studies for Crow Indian coal leases, Historic Resources, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1975d, Environmental baseline studies for Crow Indian coal leases, Hydrology, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1975e, Environmental baseline studies for Crow Indian coal leases, Land-use, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1975f, Environmental baseline studies for Crow Indian coal leases, Biology, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1976a, Application for a surface mining permit, Section 36, T.1N., R.37E., submitted to the Montana Department of State Lands in accordance with the requirements of the Montana Strip and Underground Mine Reclamation Act: Hardin, MT.

Westmoreland Resources, 1976b, Vegetation report for Section 36, T.1N., R.37E., and adjacent areas, report submitted to the Montana Department of State Lands as part of a surface mining application: Hardin, MT.

Westmoreland Resources, 1976c, Environmental baseline studies for Crow Indian coal leases, Meteorology and Air Quality, prepared by Dames and Moore, Hardin, MT.

Westmoreland Resources, 1977, Revision of Mining Plan to Application 00036: Hardin, MT.

Wyoming Geological Association, 1965, (Technical studies comm.), Geologic history of Powder River Basin; Am. Assoc. Petrel. Geologist Bull., vol. 49, no. 11, pp. 1893-1907.

IX. Other agencies contacted for information

A. Big Horn County Assessor's Office

B. Big Horn County Sheriff's Office

C. Montana Department of Community Affairs

D. Montana Department of Health and Environmental Sciences

E. Montana Department of Natural Resources and Conservation, Forestry Division

F. Montana Department of Revenue

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APPENDIX A - STATE OF MONTANA COAL LEASE NO. 1047-70, CONSOLIDATION COAL COMPANY

RECEIVED
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STATE OF [illegible]
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State of Montana
COAL LEASE

Lease No. C-1047-70

This indenture of lease, made and entered into between the State of Montana, by and through its lawfully qualified and acting State Board of Land Commissioners, hereinafter referred to as lessor, and the person, company or corporation herein named, hereinafter referred to as lessee, under and pursuant to the terms and provisions of Chapter 5, Title 81, Revised Codes of Montana, 1947, and all acts amendatory thereof and supplementary thereto, WITNESSETH:

The lessor, in consideration of the rents and royalties to be paid and the conditions to be observed as hereinafter set forth does hereby grant and lease to the lessee, for the purpose of mining and disposing of coal and constructing all such works, buildings, plants, structures and appliances as may be necessary and convenient to produce, save, care for, dispose of and remove said coal, all the lands herein described, as follows:

Date this lease takes effect: June 3, 1970

Name of Lessee: Consolidation Coal Company

Address of Lessee: 3300 One Oliver Plaza, Pittsburgh, Pennsylvania 15222

Land located in Big Horn county.

Description of Land: Township 1 North, Range 37 East
Section 36: All,

Total number of acres 640.00, more or less, belonging to School Grant.

Annual Rental, Payable each year in advance, $3,270.40 First Year
$320.00 Second, Third, Fourth & Fifth Years
$640.00 Sixth & each succeeding year thereafter

TO HAVE AND TO HOLD the said premises for a term of 20 years, together with the right, provided lessee has complied with all of the terms and conditions hereof, to lease said land for additional, successive 20-year terms. If lessee shall elect to extend this lease, lessee shall so notify lessor in writing at least 90 days prior to the expiration of the original term, or any renewal term, as the case may be. Lessor expressly reserves the right reasonably to readjust and fix royalties payable hereunder and other terms and conditions of this lease in the event lessee exercises its right to renew. Unless lessee files objections to the proposed terms or a relinquishment of the lease within 30 days after receipt of the notice of proposed terms for the ensuing 20-year renewal, lessee shall be deemed to have agreed to such terms.

IT IS MUTUALLY UNDERSTOOD, AGREED AND COVENANTED BY AND BETWEEN THE PARTIES TO THIS LEASE AS FOLLOWS:

1. RIGHTS RESERVED. The lessor expressly reserves the right to sell, lease, or otherwise dispose of any interest or estate in the lands hereby leased, except the interest conveyed by this lease, provided that the lessor hereby agrees that sales, leases or other dispositions of any interest or estate in the lands hereby leased shall be subject to the terms of this lease, and shall not interfere with the lessee's possession or rights hereunder.

2. BOND. The lessee shall immediately upon the execution of this lease furnish a surety bond in the amount of $1000.00 conditioned upon compliance with the provisions of this lease or, in the option of the lessor, a cash deposit in the amount of ______.

3. RENTAL. The lessee shall pay the lessor annually, in advance, for each acre or fraction thereof covered by this lease, beginning with the date this lease takes effect, the following rentals: $3,270.40 for the first year; $320.00 per year for the second, third, fourth, and fifth years, respectively; and $640.00 for the sixth and each succeeding year of this lease such rental for any year to be credited against the first royalties as they accrue under the lease during the year for which the rental was paid. In no case shall the annual rental payable hereunder be less than Fifty ($50.00) dollars.

4. ROYALTY. The lessee shall pay the lessor a royalty on every ton of 2,000 pounds of coal mined during the term of the lease, said royalty to be at the rate of 15¢ per ton on lignite coal and 17½¢ per ton on sub-bituminous coal, type of coal to be determined when production occurs. Royalties shall be payable quarterly within 30 days from the expiration of the quarter in which the coal is mined.

5. REPORTS. At such times and in such form as the lessor shall prescribe, the lessee shall furnish to lessor and to the Montana state bureau of mines and geology reports, plats and maps showing exploration data, development work, improvements, amount of leased deposits mined, and any other information with respect to the land leased which the lessor may require.

6. INSPECTION. The lessee shall permit at all reasonable times inspection by the lessor or the Montana State bureau of mines and geology of the leased premises and all books and records pertaining to operations and surveys or investigations under this lease. The lessee shall also permit the lessor or the Montana state bureau of mines and geology to make copies of and extracts from all books and records pertaining to operations under this lease.

7. ASSIGNMENT. This lease may not be assigned without the prior approval of the lessor in writing.

8. TERMINATION. The lessee shall have the right at the termination of any rental year, by giving at least 30 days previous notice in writing to the Commissioner of State Lands and Investments to surrender and relinquish this lease and thereupon be discharged from any obligation not theretofore accrued. The lessor may declare this lease forfeited and cancel the same through the State Board of Land Commissioners upon failure of the lessee to fully comply with the terms of this lease, after written notice from said board and reasonable time fixed and allowed by it to the lessee to perform the undertaking or obligation specified in said notice. Upon application therefore, the lessee shall be granted a hearing on any notice or demand of said Board before the lease shall be declared forfeited or cancelled.

9. SURRENDER OF PREMISES. Upon the termination of this lease for any cause the lessee shall surrender possession of the leased premises to the lessor subject to lessee's right to re-enter, hereby granted, at any time within six months after the date of such termination, for the purpose of removing all machinery and improvements belonging to the lessee except those improvements as are necessary for the preservation of the mine or deposit, which shall become the property of lessor. If any of the property of lessee is not removed from the leased premises as herein provided the same shall be deemed forfeited to the lessor and become its property.

10. PROTECTION OF THE SURFACE, NATURAL RESOURCES, AND IMPROVEMENTS. The lessee agrees to take such reasonable steps as may be needed to prevent operations from unnecessarily: (1) causing or contributing to soil erosion or damaging any forage and timber growth thereon; (2) polluting the waters of springs, streams, wells, or reservoirs; (3) damaging crops, including forage, timber, or improvements of a surface owner; or (4) damaging range improvements whether owned by the lessor or by its grazing permittees or lessees; and upon any partial or total relinquishment or the cancellation or expiration of this lease, or at any other time prior thereto when required by the lessor and to the extent deemed necessary by the lessor, to fill any sump holes, ditches and other excavations, remove or eover all debris, and, so far as reasonably possible, restore the stripped area and spoil banks to a condition in keeping with the concept of the best beneficial use, including the removal of structures as and if required. The lessor may prescribe the steps to be taken and restoration to be made with respect to lands of the lessor and improvements thereon.

11. TAXES. The lessee shall pay when due all taxes lawfully assessed and levied upon improvements, output of mines, or other rights, property or assets of the lessee.

12. SUCCESSORS IN INTEREST. Each obligation hereunder shall extend to, and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors or assigns of the respective parties hereto.

IN WITNESS WHEREOF, the parties hereto set their hands and the lessor has caused this agreement to be executed with the official seal of the State Board of Land Commissioners on this [illegible] day of [illegible], 19[illegible].

THE STATE OF MONTANA, LESSOR
By Its State Board of Land Commissioners.

FORREST H. ANDERSON President

Ted Schwinden Secretary

Attest:

By
Assistant Secretary

CONSOLIDATION COAL COMPANY
By
Vice President Lessee

Address of Lessee. 3300 One Oliver Plaza
Pittsburgh, Pennsylvania 15222

COAL LEASE FORM NO. 1
Under Chapter 5, Title 81, R.C.M. 1947

No. C-1047-70

State of Montana
COAL LEASE

Lessee Consolidation Coal Company

Address Pittsburgh, Pennsylvania 15222

In Effect From May 3, 1970

Date Granted by Board June ~~XXX~~ 3, 1970

Checked by

Fees and Rental Entered

Registered

By

2M-11-67-217

APPENDIX B - CHEMICAL PROPERTIES OF SOIL FROM HORIZON MATERIALS SAMPLED WITHIN TRACT III

(WESTMORELAND RESOURCES, 1975b)

TABLE 2.2.4-2

Sheet 1 of 12

CHEMICAL PROPERTIES OF SOIL FROM HORIZON MATERIALS SAMPLED WITHIN TRACT III

						Saturation Extract						
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation[a] (%)	Conductivity (mmhos/cm)	Ca[b]	Mg[b] Meq/1	Na[b]	SAR	Boron[c] (ppm)
73-1	Cushman Loam	A	0-6	L+	7.9		0.4	+35.0	4.3	0.1		
		B	6-13	SiCL	8.1		0.3	+35.0	5.9	0.1		
		C	13-19	SiCL	8.5		0.3	+35.0	11.5	0.1		
			19-30	SiCL	8.2		0.3	+35.0	13.3	0.1		
			30-38	SiCL	8.4		0.4	+35.0	11.9	0.1		
		R	38-65	SiL	8.5		0.5	+35.0	10.5	0.1		
			Soft Silty Shale									
73-2	Nelson Fine Sandy Loam	A	0-2	FSL	8.0		0.2	7.5	2.68	0.3	3.5	
		B	2-7	FSL+	8.0		0.1	7.5	2.45	0.1		
			7-13	FSL+							8.2	
			13-21	SiL+	8.5		0.3	+35.0	3.15	0.1		
		C	21-27	FSL	8.3		0.3	+35.0	11.5	0.1		
			27-49	FSL	8.2		0.2	+35.0	3.63	0.1	3.6	
		R	49+-Hard Sandstone									

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[a] Saturation percentage not tested on 1973 samples nor on 74-18, -19, and -20.

[b] Cation concentrations reported for soils sampled in 1973 are recorded as meq/100g since extraction was accomplished with ammonium acetate

[c] Boron concentration not tested for on 1973 samples

TABLE 2.2.4-2

Sheet 2 of 12

					Saturation Extract							
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation^a (%)	Conductivity (mmhos/cm)	Ca^b	Mg^b Meq/l	Na^b	SAR	Boron^c (ppm)
73-3	Cushman Loam	A	0-6	FSL+	7.9		0.2	13.3	4.78	0.1	3.25	
		B	6-11	L	7.8		-0.1	14.6	5.0	0.1	2.49	
			11-15	L	7.9		0.3	34.5	5.7	0.1		
		C	15-27	SiL	8.3		0.32	+35.0	1.28	0.1	1.44	
			27-38	L	8.2		0.3	+35.0	4.3	0.1	2.23	
			38-63	L	8.5		0.3	32.3	14.0	0.1	3.52	
		R	63+—Soft Shale and Sandstone									
73-4	Wibaux Gravelly Loam	A	0-5	L	8.1		0.4	14.6	2.95	0.1	2.79	
		C	5-12	L	8.0		0.2	17.7	2.68	0.1	3.13	
			12-18	L	7.7		0.3	13.3	2.68	0.1	3.77	
		R	18+—Hard, Platy Shale and Sandstone									
73-5	Spearman Loam	A	0-3	L	7.5		0.3	13.37	3.63	0.1	3.12	
		B	3-9	L+	7.9		0.3	+35.0	4.3	0.1	1.63	
			9-14	L+	7.7		0.4	12.5	3.8	0.1	2.99	
		C	14-25	CL-	8.5		0.4	+35.0	6.63	0.1		
			24-36	L	8.5		0.3	+35.0	10.78	0.1		
		R	36+—Hard, Platy Shale									
73-6	Wibaux Gravelly Loam	A	0-3	L+	8.1		0.3	28.5	3.15	0.1	2.09	
		C	3-11	L+	8.0		0.4	+35.0	3.8	0.1	2.63	

TABLE 2.2.4-2

Sheet 3 of 12

Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation[a] (%)	Saturation Extract: Conductivity (mmhos/cm)	Saturation Extract: Ca[b]	Saturation Extract: Mg[b] Meq/l	Saturation Extract: Na[b]	SAR	Boron[c] (ppm)
73-7	Thedalund Loam	A	0-4	L+	8.0		0.3	+35.0	4.78	0.1	1.48	
		C	4-9	L+	8.1		0.4	17.3	3.8	0.1	2.04	
			9-13	SiCL-	8.1		0.3	+35.0	7.55	0.1	1.93	
			13-21	SiCL	8.3		0.4	+35.0	12.38	0.1	2.7	
		CR	21+—Soft, Platy Shale									
73-8	Spearman Loam	A	0-4	L	7.9		0.2	13.37	3.4	0.1	1.32	
		B	4-9	L	8.0		0.2	13.37	1.55	0.1	2.15	
			9-13	L	8.0		0.2	21.5	3.63	0.1	2.48	
		C	13-18	L-	7.8		0.3				1.76	
			18-35	L	8.3		0.3	+35.0	4.55	0.1	2.96	
		R	35+—Hard, Platy Shale									
73-9	Thedalund Loam	A	0-3	L+	7.1		0.5	+35.0	2.7	0.1		
		C	3-9	CL-	7.1		0.4	+35.0	2.5	0.1		
			9-20	CL	7.8		0.3	+35.0	4.6	0.1		
		R	20+—Platy Shale									
73-10	Fort Collins Loam	A	0-3	L	7.2		0.4	9.5	4.3	0.1		
		B	3-6	L	7.3		-0.16	7.9	4.8	0.1		
			6-10	L	7.2		-0.16	8.8	5.4	0.1		
		C	10-17	L	7.6		0.3	+35.0	5.9	0.1		
			17-27	L	7.9		0.5	31.1	7.1	0.1		
			27-65	SL	8.3		0.3	25.5	10.3	0.1		

TABLE 2.2.4-2

							Saturation Extract					
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation^a (%)	Conductivity (mmhos/cm)	Ca^b	Mg^b Meq/l	Na^b	SAR	Boron^c (ppm)
73-11	Nelson	A	0-5	FSL	7.7		0.3	+35.0	2.95	0.1	1.08	
	Fine	B	5-12	FSL	7.7		-0.1	6.15	2.2	0.1	1.72	
	Sandy	C	12-23	FSL	7.8		0.2	8.75	2.45	0.1	1.61	
	Loam		23-34	SL	7.8		0.3	+35.0	2.95	0.1	1.98	
		CR	34+–Sandstone									
73-12	Fort	A	0-2	SiL+	7.1		0.3	9.1	4.3	0.1		
	Collins	B	2-5	SiL+	6.1		0.4	12.5	5.4	0.1		
	Loam		5-11	SiCL-	6.4		0.2	13.9	7.6	0.1		
		C	11-18	CL	7.3		0.4	+35.0	7.6	0.1		
			18-28	SiC	7.8		0.6	+35.0	+23.0	0.1		
			28-58	VFSL+	8.0		2.6	+35.0	20.1	1.3		
74-13	Thedalund-	Disturbed	0-6	SCL	7.3	26.8	7.6	14.3	13.8	2.5	0.67	1.44
	Wibaux	Soil	6-14	SCL	7.4	27.3	9.4	22.3	17.2	3.4	0.76	0.43
	Complex		14-21	LS	7.4	22.0	12.7	26.0	2.18	7.5	1.54	12.40
74-14	Thedalund-	Disturbed	0-6	SCL	7.3	29.1	3.4	6.5	3.8	1.0	0.43	0.30
	Wibaux	Soil	6-12	SCL	7.5	28.2	2.6	5.0	2.2	0.5	0.26	0.30
	Complex		12-24	C	7.1	34.2	5.2	8.4	11.3	1.3	0.41	0.43
			24-36	SL	7.1	25.9	3.5	4.8	5.5	1.0	0.44	0.71
74-15	Thedalund-	Disturbed	0-6	SCL	7.3	26.4	2.1	4.5	1.4	0.2	0.10	0.30
	Wibaux	Soil	6-12	SCL	7.6	25.3	2.7	5.4	1.6	0.2	0.09	0
	Complex		12-24	SL	7.4	26.2	3.6	8.4	3.1	0.4	0.16	0.30
			24-33	SCL	7.4	25.5	3.1	5.8	2.6	0.7	0.34	0.43

TABLE 2.2.4-2

					Saturation Extract							
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation[a] (%)	Conductivity (mmhos/cm)	Ca	Mg ----- Meq/1 -----	Na	SAR	Boron (ppm)
74-16	Chugter Loam	A	0-4	SL	5.9	30.3	1.8	1.6	1.2	0.2	0.14	0
		B	4-8	L	6.5	27.8	2.8	3.9	2.3	0.2	0.10	0.43
			8-13	L	7.0	29.8	2.7	4.5	2.3	0.2	0.09	0
		C	13-26	SCL	7.6	29.6	2.1	2.8	1.8	0.3	0.20	0.43
			26-65	CL	7.7	27.0	13.3	13.5	38.5	7.7	1.50	2.87
74-17	Chugter Loam	A	0-4	SCL	7.0	27.6	2.9	5.2	3.1	0.3	0.15	0.43
		B	4-10	SL	6.9	24.9	1.9	3.4	1.6	0.3	0.20	0.00
			10-15	SL	7.0	26.5	1.8	3.0	1.4	0.2	0.11	0.30
		C	15-21	SL	7.4	26.7	1.7	3.0	1.4	0.2	0.11	0.30
			21-29	SL	7.5	25.2	1.4	1.6	1.4	0.2	0.14	0.30
			29-65	SL	7.7	23.9	1.6	0.6	2.0	0.6	0.53	0.30
74-18	d	A and B	0-6	L	7.8		0.62	3.18	1.96	0.20	0.12	<1
		B	6-12	L/CL	8.2		0.76	4.65	2.46	0.19	0.10	1.8
			12-21	L	8.2		0.70	4.47	2.34	0.30	0.16	<1
		C	21-30	L	8.1		1.96	6.08	14.90	3.96	1.22	<1
			30-65	SCL & L	7.8		14.20	18.58	141.49	5.13	0.57	5.3

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[d] Not defined at time of sampling; obtained in area of Thurlow-Midway silty clay loam (To) at site of mine administration building.

TABLE 2.2.4-2

Sheet 6 of 12

					Saturation Extract							
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation[a] (%)	Conductivity (mmhos/cm)	Ca	Mg	Na	SAR	Boron (ppm)
								------	Meq/l	------		
74-19	d	A and B	0-6	L	8.0		0.68	4.83	2.43	0.17	0.07	<1
		B	6-12	L/CL	8.2		0.41	3.67	1.64	0.14	0.09	1.8
		C	12-21	L	8.6		0.37	2.26	1.96	0.18	0.13	<1
			21-31	L	8.6		0.37	1.34	2.71	0.24	0.17	1.8
			31-47	SL	8.7		0.41	0.63	3.13	0.77	0.56	<1
			47-60	L	8.8		0.68	0.41	3.33	3.31	2.42	1.5
74-20	d	A and B	0-6	L	8.5		0.72	5.72	2.09	0.10	0.05	<1
		B and C	6-12	L/SL	8.4		0.52	3.93	1.54	0.12	0.07	<1
		C	12-17	SL	8.6		0.42	2.51	1.74	0.13	0.09	1.3
		C	17-65	SL	8.7		0.44	1.08	3.38	0.32	0.21	3.0
74-21	Chugter Loam	A	0-6	SL	8.28	38.4	0.91	0.74	0.24	0.02	<1	0.3
		B	6-11	SL	8.04	35.4	1.65	1.23	0.41	0.02	<1	0.9
		C	11-17	SL	8.24	34.3	0.52	0.38	0.15	0.01	<1	0.3
			17-26	SL	8.28	32.1	0.42	0.30	0.13	0.02	<1	0.5
			26-60	SL	8.35	31.7	0.38	0.15	0.20	0.01	<1	0.5
74-22	Chugter Loam	A	0-6	SL	7.90	36.5	0.83	0.50	0.29	0.01	<1	0.3
		B	6-11	SL	7.93	35.4	1.08	0.64	0.36	0.03	<1	0.4
		C	11-18	SL	7.93	35.1	2.08	1.48	0.60	0.02	<1	0.8
			18-27	L	8.53	34.9	0.52	0.24	0.19	0.02	<1	0.9
			27-60	L	8.52	37.3	0.52	0.14	0.28	0.02	<1	1.9

TABLE 2.2.4-2

						Saturation Extract						
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation (%)	Conductivity (mmhos/cm)	Ca -----	Mg Meq/1	Na -----	SAR	Boron (ppm)
75-23	Thedalund Loam	A and C	0-6	L	7.6	46.29	0.38	5.83	3.14	0.22	0.10	3.02
		C	6-11	SiL	7.7	45.61	0.54	3.30	2.21	0.13	0.08	2.01
			11-22	SiL	7.9	48.25	0.60	2.17	2.73	0.65	0.42	2.35
		CR	22-28	Platy Siltstone and Shale								
75-24	Spearman Loam	A and B	0-6	L	7.3	43.73	0.40	4.46	2.37	0.43	0.23	2.18
		B	6-9	L	7.5	42.13	0.54	3.98	1.73	0.35	0.21	2.01
			9-15	L	7.9	42.77	0.73	2.21	1.28	0.35	0.27	1.34
		C	15-31	L	7.9	35.47	0.73	1.85	2.49	0.35	0.24	1.68
		R	31-38	Platy, Hard Shale and Sandstone								
75-25	Nelson Fine Sandy Loam	A	0-6	SL	7.3	35.19	0.45	4.38	2.65	0.35	0.19	2.01
		B	6-12	SL	7.5	33.37	0.54	3.42	2.01	0.43	0.26	1.34
		C	12-21	SL	7.8	34.17	0.75	2.65	0.90	0.24	0.18	0.67
			21-43	SL	8.0	33.33	0.85	1.95	0.90	0.26	0.22	1.01
		R	43-50	Sandstone								
75-26	Cushman Loam	A	0-6	SL	7.2	38.88	0.46	4.30	1.56	0.28	0.16	2.01
		A and B	6-11	SL	7.0	42.07	0.50	4.15	1.39	0.22	0.13	1.17
		B	11-19	L	7.6	42.45	0.65	2.10	0.98	0.20	0.16	1.68
		C	19-25	L	7.7	39.00	0.65	2.35	1.80	0.33	0.23	1.68
			24-41	L	7.8	35.98	0.65	1.50	2.54	0.61	0.43	1.34
		CR	41-46	Loamy and Sandy Shales								

TABLE 2.2.4-2

					Saturation Extract						
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation (%)	Conductivity (mmhos/cm)	Ca	Mg Meq/l	Na	SAR	Boron (ppm)
75-27	Nelson	A and B	0-6	SL	7.0	39.62	0.41	4.55	2.30	0.17	0.09	1.34
	Fine	B	6-9	SL	7.3	39.59	0.65	2.90	1.31	0.17	0.12	1.34
	Sandy	C	9-19	SL	7.6	33.22	0.60	3.40	0.98	0.20	0.14	1.34
	Loam		19-39	SL	7.8	35.94	0.85	2.00	0.98	0.24	0.20	0.84
		CR	39-44	Soft Sandstone								
75-28	Fort	A	0-6	SL	6.5	35.74	0.39	4.80	2.21	0.26	1.28	2.35
	Collins	B	6-11	L	6.5	42.26	0.35	2.30	1.39	0.22	0.16	1.34
	Loam		11-14	L	7.0	42.12	0.33	2.50	1.39	0.26	0.19	1.68
		C	14-20	L	8.0	35.15	0.36	2.85	1.48	0.30	0.20	2.01
			20-32	L	8.1	33.38	0.33	2.05	1.56	0.26	0.19	0.67
			32-60	SL	8.2	31.98	0.36	1.50	2.38	0.35	0.25	0.34
75-29	Cushman	A	0-6	SL	6.9	33.33	0.50	4.25	2.46	0.22	0.12	0.67
	Loam	A and B	6-10	L	7.0	41.39	0.50	5.15	3.20	0.22	0.11	0.34
		B	10-19	CL	8.0	43.27	0.37	2.45	1.72	0.22	0.15	0.34
		C	19-38	CL	8.1	42.21	0.36	1.60	2.54	0.30	0.21	0.67
		CR	38-44	Soft, Platy Shale								
75-30	Fort	A and B	0-6	L	6.8	36.43	0.60	5.35	3.61	0.17	0.08	2.01
	Collins	B	6-9	L	6.6	39.21	0.39	3.30	2.05	0.22	0.13	0.34
	Loam		9-16	L	7.4	41.86	0.55	4.90	4.26	0.26	0.12	0.34
			16-22	L	7.8	39.14	0.32	2.65	1.89	0.35	0.23	0.67
		C	22-32	CL	8.2	39.12	0.28	1.45	2.13	0.43	0.32	0.34
			32-60	CL	8.4	39.58	0.33	0.75	3.03	1.22	0.89	0.00

TABLE 2.2.4-2

					Saturation Extract							
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation (%)	Conductivity (mmhos/cm)	Ca	Mg Meq/l	Na	SAR	Boron (ppm)
75-31	Thedalund	A	0-6	L	7.7	46.69	0.42	5.25	1.23	0.26	0.14	1.68
	Loam	C	6-13	CL	7.9	41.58	0.37	3.25	1.39	0.26	0.17	1.01
			13-22	L	8.0	37.60	0.36	2.90	1.64	0.30	0.20	1.01
		CR	22-28	Soft, Platy Shale and Sandstone								
75-32	McRae	A and B	0-6	SCL	7.5	36.1	1.02	6.79	2.67	0.78	0.36	0.39
	Loam		6-10	L	8.1	29.0	0.40	2.69	1.13	1.0	0.72	0.12
		C	10-20	SCL	8.2	31.3	0.47	1.82	0.93	0.78	0.67	0.10
			20-28	SCL	8.4	28.3	0.44	0.85	1.44	0.78	0.73	0.06
			28-52	SCL	8.5	25.9	0.89	0.67	2.26	4.0	3.31	0.13
			52-70	SL	8.7	28.7	0.60	0.02	1.85	3.09	3.19	0.34
			70-84	SL	8.7	22.6	0.94	0.22	1.34	6.74	7.66	0.41
75-33	Wibaux	A and C	0-6	SL	7.4	49.9	1.17	6.89	2.16	0.91	0.43	0.64
	Gravelly	C	6-18	SL	8.1	50.8	0.77	3.39	2.57	1.09	0.63	1.05
	Loam	R	18-24	Shattered Hard Shale and Sandstone								
75-34	Midway	A and C	0-6	SL	7.6	45.3	0.88	2.99	2.67	1.91	1.14	0.60
	Silty	C	6-10	SCL	7.9	44.3	0.79	1.62	2.36	3.17	2.25	0.38
	Clay		10-18	SC	8.0	47.3	0.71	17.93	46.75	29.57	5.20	2.12
	Loam	CR	18+	Soft, Platy Shale								

TABLE 2.2.4-2

					Saturation Extract							
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation (%)	Conductivity (mmhos/cm)	Ca	Mg Meq/1	Na	SAR	Boron (ppm)
75-35	Chugter Loam	A and B	0-6	L	6.8	38.9	1.0	4.37	2.78	1.61	0.85	0.52
		B and C	6-11	SCL	7.3	40.1	0.79	4.37	2.16	0.91	0.50	0.70
		C	11-19	SCL	8.0	37.2	0.58	4.67	1.13	1.0	0.59	0.56
			19-26	SCL	8.1	33.3	0.60	1.62	1.85	1.09	0.83	0.52
			26-50	SCL	8.2	32.5	2.55	3.79	16.45	3.39	1.07	1.18
			50-74	SL	8.2	33.2	5.60	8.08	45.76	7.00	1.35	2.02
			74-84	CL	8.1	29.9	5.81	10.43	46.75	9.83	1.83	2.99
75-36	Alice Sandy Loam	A and B	0-6	SL	7.0	30.4	0.67	2.89	2.06	0.61	0.39	0.25
		B	6-10	SL	7.0	37.5	0.56	2.59	1.44	0.78	0.55	0.22
			10-19	SL	7.0	30.0	0.54	2.30	1.34	0.91	0.67	0.20
			19-30	SL	7.4	29.7	0.60	2.50	1.34	0.91	0.65	0.13
		C	30-54	SL	8.0	27.8	0.62	2.59	0.93	1.09	0.82	0.10
			54-73	SL	8.2	27.6	0.49	1.52	0.82	1.30	1.20	0.07
			73-84	LS	8.1	27.8	0.80	2.99	1.95	1.39	0.89	0.07
75-37	Spearman Loam	A and B	0-6	SL	7.1	44.6	0.84	4.37	1.64	0.70	0.40	0.47
		B	6-9	SL	7.4	41.8	0.82	3.77	1.34	1.09	0.68	0.30
		C	9-15	SCL	7.9	43.6	0.53	2.79	0.93	0.61	0.45	0.33
			15-28	SL	8.0	36.9	0.53	2.20	1.13	1.09	0.84	0.25
		R	28-34-Shattered, Hard, Red Shale									
75-38	Chugter Loam	A	0-6	L	6.8	43.8	0.69	2.69	1.34	0.78	0.55	0.63
		B	6-14	L	7.4	40.0	0.78	3.29	1.85	0.78	0.49	0.61
		C	14-22	SCL	7.9	37.1	0.73	2.89	1.34	0.78	0.53	0.72
			22-46	CL	8.4	31.0	0.54	1.35	1.34	1.00	0.86	1.28
			46-63	SCL	8.4	28.4	1.00	2.02	3.91	1.39	0.81	2.99
			63-84	CL	8.2	32.7	2.10	6.31	9.15	1.91	0.69	4.04

TABLE 2.2.4-2

					Saturation Extract							
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation (%)	Conductivity (mmhos/cm)	Ca	Mg Meq/l	Na	SAR	Boron (ppm)
75-39	Alice	A and B	0-6	SL	6.6	29.5	0.45	2.59	1.64	0.61	0.42	1.11
	Sandy	B	6-14	SL	6.9	26.5	0.58	1.72	1.13	0.70	0.58	0.96
	Loam		14-21	SL	6.9	31.1	0.43	1.82	1.34	0.91	0.72	0.89
			21-31	SL	7.3	116.2	0.48	2.40	1.85	0.61	0.42	0.89
		C	31-54	SL	8.1	29.5	0.71	1.35	1.13	1.17	1.05	0.86
			54-75	SL	8.2	26.1	0.46	1.62	0.93	1.51	1.42	0.78
			75-84	LS	8.4	26.6	0.35	0.95	0.93	1.30	1.34	0.75
75-40	Midway	A and C	0-6	CL	7.4	49.5	0.79	5.64	2.78	0.09	0.04	0.96
	Silty	C	6-11	CL	7.9	50.2	0.49	2.79	1.64	0.09	0.06	0.69
	Clay		11-20	SiCL	8.2	65.2	0.33	0.85	1.85	0.09	0.08	0.70
	Loam	CR	20-24-Platy Shale									
75-41	Nunn	A and B	0-6	SL	7.0	39.1	0.63	3.87	3.08	0.04	0.02	0.81
	Silty	B	6-10	CL	7.1	39.2	0.58	2.79	2.26	0.39	0.25	0.75
	Clay		10-16	CL	8.1	39.0	0.52	2.02	2.16	0.09	0.06	0.78
	Loam	C	16-28	CL	8.0	37.6	0.27	3.59	19.74	3.70	1.04	0.71
			28-38	L	8.3	39.1	0.66	13.57	68.26	14.78	2.31	0.92
			38-59	L	8.5	38.2	11.00	15.07	111.02	25.22	3.18	0.99
			59-83	L	8.5	33.2	4.80	5.26	24.26	8.09	2.11	0.92
75-42	Wibaux	A and B	0-6	L	6.6	44.1	0.71	3.09	2.67	0.04	0.02	0.47
	Gravelly	B	6-11	CL	7.1	42.2	0.85	4.07	3.91	0.17	0.09	0.23
	Loam	B and C	11-27	CL	7.9	45.8	0.49	1.82	2.57	0.04	0.03	0.34
		C	27-35	CL	8.4	45.3	0.55	0.57	3.16	0.61	0.52	0.31
			35-59	L	8.6	33.3	0.55	0.40	2.78	1.30	1.03	0.61
			59-83	L	8.7	40.0	0.62	0.67	5.24	3.00	1.74	0.58

TABLE 2.2.4-2

						Saturation Extract						
Sample	Soil Type	Horizon	Depth (inches)	Texture	pH	Saturation (%)	Conductivity (mmhos/cm)	Ca	Mg Meq/l	Na	SAR	Boron (ppm)
75-43	Nunn	A and B	0-6	L	6.6	44.1	0.71	3.09	2.67	0.04	0.02	0.47
	Silty	B	6-11	CL	7.1	42.2	0.85	4.07	3.91	0.17	0.09	0.23
	Clay	B and C	11-27	CL	7.9	45.8	0.49	1.82	2.57	0.04	0.03	0.34
	Loam	C	27-35	CL	8.4	45.3	0.55	0.57	3.16	0.61	0.52	0.31
			35-59	L	8.6	33.3	0.55	0.40	2.78	1.30	1.03	0.61
			59-83	L	8.7	40.0	0.62	0.67	5.24	3.00	1.74	0.58
75-44	McRae	A and B	0-6	SL	7.7	34.8	0.72	3.19	2.06	0.17	0.10	0.85
	Loam	B	6-10	SCL	7.9	39.1	0.47	1.92	2.16	0.04	0.03	0.37
		C	10-15	CL	8.1	38.0	0.40	0.85	2.67	0.17	0.13	0.45
			15-28	SCL	8.5	36.7	0.43	0.95	3.60	0.17	0.11	0.35
			28-52	SCL	8.6	30.7	0.47	0.40	2.67	0.70	0.56	0.64
			52-76	SCL	8.6	30.0	0.47	0.12	3.50	0.91	0.67	0.29
			76-84	SCL	8.9	29.2	0.50	0.30	0.82	5.83	7.77	0.27

APPENDIX C - MEMORANDUM FROM MIKE BISHOP TO COAL BUREAU STAFF
JANUARY 7, 1977

STATE OF MONTANA

DEPARTMENT OF STATE LANDS

STATE CAPITOL HELENA 59601 (406) 449-2074

STATE BOARD OF
ND COMMISSIONERS
HOMAS L. JUDGE
GOVERNOR
OLORES COLBURG
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FRANK MURRAY
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BERT L. WOODAHL
ATTORNEY GENERAL
. "SONNY" OMHOLT
AUDITOR

TED SCHWINDEN
COMMISSIONER

ESOURCE
FOR THE
ESENT

PPORTUNITY
FOR THE
TURE

January 7, 1977

MEMO

TO: Coal Bureau Staff, C. C. McCall, Leo Berry, Jr.

FROM: Mike Bishop

RE: Westmoreland Section 36 application

State Section 36 (T1S, R38E) is a valuable resource to the people of Montana in terms other than the sale of coal.

1. As a range resource the section has been determined to be the most valuable state section, for a radius of 24 miles, in terms of grazing capacity as determined by the Department of State Lands grazing allotments. It is realized that the range is not in prime condition at this point but ranchers have admitted over using the area because of the thought that it would soon be disturbed by mining.

2. Water is an essential element of any grazing resource and section 36 has an ample supply of high quality water.

3. Section 36 offers a diverse vegetative composition that enhances both wildlife and domestic stock values.

4. The topography of section 36 is varied and is partially responsible for the vegetative diversity.

The main spring in section 36, designated as spring 237 in the Dames and Moore Westmoreland report, has been a reliable source of water for the past 50 years. Mrs. Vella Redding who homesteaded adjacent to section 36 in 1928 verifies the reliability of spring 237 for stock watering from the time of her arrival to the present.

The quality of water from spring 237 falls well within the U.S. Public Health Service drinking water standards with the exception of the total dissolved solids concentration which is 92 mg./l over the recommended value. When compared with the t.d.s. concentrations for domestic water supplies for the Tract III area and area to the north and east of Tract III provided by Van Voast and Hedges (1974) the t.d.s. concentration of spring 237 is lower than 93 percent of the t.d.s. values for domestic water. The t.d.s. value for spring 237 falls 967 mg/l lower than the mean t.d.s. value for domestic water supplies in the Tract III and adjacent area and 808 mg/l lower than the mean value for t.d.s. concentrations from springs in the same area. Additional selected water quality parameters (Total Hardness, SO_4, NO_3, conductivity and Sodium Adsorption Ratio) for the same domestic water supplies were compared with spring 237 with the conclusion that the state spring had lower values than at least 69% of domestic supplies for all parameters. The springs were compared for the same parameters with similar results, spring 237 was lower than at least 70% of the springs compared for all parameters except sodium adsorption ratio. The sodium adsorption ratio for spring 237 was lower than 55% of all other springs compared and had a value of half the mean for all springs.

Spring 238 also in section 36 should have similar quality to that of spring 237 since both receive water from the same aquifer, the Rosebud McKay Coal. The quantity of water at the surface of this spring is minimal largely because the spring has not been developed for many years.

The presence of the two springs on section 36, the configuration of the Rosebud McKay potentometric water level contours, and the location of the outcrop of the Rosebud McKay Coal suggests that ground water in the form of interflow could be very near the land surface along the drainage bottoms. The potentiometric water level contours for the Rosebud McKay Coal that are verified by a well in section 36 indicate a static water level to within five feet of the surface. Springs 237 and 238 seem to correspond to the location of the outcrop of the coal which surrounds the drainage bottom. It is reasonable to say that groundwater can exist in the coal aquifer close to the ground surface and be discharged from the coal outcrop to the drainage bottom soil and colluvium and be transmitted as interflow towards the middle fork of Sarpy Creek.

Vegetation on the drainage bottom, occurring where no surfac expression of water can be seen, including species such as Fraxinus pennsylvanica (green ash), Crataegus spp. (hawthorns), Prunus americana (American plum), and Rosa woodsii (woods rose) add diversity to the range vegetation present on the section, and many are valued wildlife browse species. In Booth and Wright's Flora of Montana (1966) each of these species are described as streamside vegetation with the exception of Rosa woodsii which may occur on higher but still moist slopes. Symphoricarpos albus (snowberry) is also present over much of the coulee bottom directly below springs 237 and 238. Although this plant can occur on drier slopes it is obviously taking advantage of excess moisture available and offers browse for both wildlife and domestic stock. Similarly grasses present along the moist bottom remain green longer than the sidehill grasses that cure more rapidly through the summer. The more lush vegetation along the bottom offers more protein in a more palatable form that can sustain heavier usage than the typical range vegetation on the hillside.

The geology of section 36 strongly suggests that subirrigation is possible for native plant species along the coulee bottoms and the plant response in this area further substantiates this contention.

The topography of Section 36 includes abrupt breaks or scoria buttes in the west central portion of the section which provide steep slopes and well drained soils on exposures that are conducive to ponderosa pine (Pinus ponderosa) and skunk brush (Rhus trilobata) both of which add to the vegetative diversity of the section. Skunk brush is also a valuable browse species.

The surface resources of section 36 provide a diverse high quality environment for both domestic livestock and wildlife that is largely dependent on unique conditions present in the section. The theorized subirrigated nature of the drainage bottom, high quality continuous water supply, varied topography and diverse vegetation is a package that would be impossible to reclaim in total. Specifically the well-drained steep scoria buttes and subirrigated coulee bottom, which are responsible for much of the vegetative diversity, are unreclaimable to its present state. If this area is allowed to be mined, the elements responsible for the diversity and therefore the increased value of the section will be lost which will change the character of the area upon reclamation.

In order to preserve the groundwater situation occurring in section 36 mining would have to be prohibited to the southeast which provides for the movement of recharge to this area. It should also be pointed out that replacement of the water supply on section 36 by Westmoreland post mining will most likely be in the form of a well and the cost of pumping will most likely be borne by the state in the future.

TABLE 2.2.3-2

Sheet 1 of 2

DISCHARGE MEASUREMENTS MADE DURING THIS INVESTIGATION,
STATIONS SW-1, SW-2, SW-4, AND SW-5, IN THE PROJECT AREA

Date	Discharge (cfs) SW-1	SW-2	SW-4	SW-5
ch 4, 1975				1.5
5, 1975				1.0
7, 1975	14.4	10.1	2.8	0.6
8, 1975	15.9	12.7	2.2	
9, 1975	10.7	4.0	1.4	0.5
10, 1975	9.4	5.6		0.5
11, 1975			1.7	
12, 1975			1.3	
13, 1975		6.0		0.8
14, 1975	1.6	4.3	1.8	
15, 1975		68.3		
17, 1975	39.6		24.2	0.6
18, 1975	19.4	63.9	26.2	
19, 1975	30.4	78.1	19.7	0.4
20, 1975	20.0	72.4	10.6	0.4
21, 1975				0.4
24, 1975		7.5	1.0	0.4
25, 1975		7.4	1.0	0.4
26, 1975	0.8	6.5	1.0	0.5
27, 1975	1.0	6.3	1.0	
28, 1975	1.0			
30, 1975	1.0	3.8	1.2	0.6
31, 1975	0.7	3.8	1.0	
l 1, 1975	0.7	3.3	1.0	
2, 1975	0.7	3.1	1.5	0.3
3, 1975	0.8	3.7	9.3	0.4
4, 1975	0.8	8.3	5.4	0.3
5, 1975	0.8	3.5	2.2	0.2
7, 1975	0.8	6.7	1.2	0.2
9, 1975	0.8	3.4	1.1	
10, 1975	0.7	8.6	1.0	
11, 1975	0.7	5.7	1.0	0.4
12, 1975	0.7	6.1	1.0	
13, 1975	0.8	7.8	1.1	0.4
14, 1975	1.4	16.2	5.4	
15, 1975	1.1	43.8	3.6	0.4
16, 1975	2.3	40.1	1.5	0.4

TABLE 2.2.3-2

	Discharge (cfs)			
Date	SW-1	SW-2	SW-4	SW-5
April 17, 1975	1.4	31.2	1.2	0.4
18, 1975	1.0	11.4	1.2	0.4
19, 1975	0.8	10.6		
21, 1975	0.7	6.2	1.0	0.1
22, 1975	0.7	5.3	1.0	0.3
25, 1975	0.6	4.8	1.0	0.3
30, 1975	1.2	8.9	1.2	0.9
May 1, 1975	1.3			
2, 1975				0.4
6, 1975	1.1	10.2		
7, 1975	1.7	2.3	2.0	0.5
8, 1975	1.9	21.2	1.1	
9, 1975	1.7	10.6	1.1	0.5
15, 1975	0.7	4.4	1.0	0.5
23, 1975	0.7	4.8	1.0	0.5
29, 1975	0.5	2.8	0.8	0.5
June 4, 1975	0.4	2.0	0.7	0.5
12, 1975	0.4	2.4	0.8	0.5
18, 1975	0.4	1.5	0.9	0.5
26, 1975	0.4	1.5	0.8	0.5
July 11, 1975	0.2	0.7	0.4	0.5
17, 1975	0.1	0.5	0.3	0.5
21, 1975	dry	dry	0.2	0.5
August 8, 1975	dry	dry	0.1	0.4
15, 1975	dry	dry	0.2	0.5
20, 1975	dry	dry	0.3	0.5

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

PLEASE ADDRESS ALL CORRESPONDENCE TO:
P. O. Box 494, Hardin, Montana 59034

OFFICE TEL (406) 342-5269

SINCE 1908

WESTMORELAND RESOURCES
P. O. Box 449
Hardin, Montana 59034

December 2, 1976

Sample Identification
by COMMERCIAL TESTING & ENGINEERING CO.

Station 6

Sarpy Creek, upstream of Middle Fork

Kind of sample reported to us Water

Sample taken at Absoloka Mine, Sarpy Creek, Montana

Sample taken by COMMERCIAL TESTING & ENGINEERING CO. (Automatic Sampler)

Date Sampled November 18, 1976

Date Received November 18, 1976

Analysis report no. 75-W00155

1.	pH	7.9		Salinity = 1.25 gr./kgr.
2.	Turbidity	Less than 25	JTU	Conductivity = 2050 umhos/cm.
3.	Acidity to pH 8.2	0	meq/l	
4.	Alkalinity to pH 4.5	15.38	meq/l	
5.	Alkalinity as $CaCO_3$	770	mg/l	
6.	Total Dissolved Solids (105°C)	3057	mg/l	
7.	Total Suspended Solids	7	mg/l	
8.	Settleable Solids	0.4	ml/l	
9.	Total Iron	.06	mg/l	
10.	Dissolved Iron	.01	mg/l	
11.	Fluoride	.42	mg/l	
12.	Sulfates	1400	mg/l	
13.	Total Oil and Grease	Less than 5	mg/l	
14.	5-day BOD	NA	mg/l	
15.	Fecal Coliform	NA	Colonies/100 ml	

meq/l = milliequivalents per Liter
mg/l = milligrams per Liter
ml/l = milliliters per Liter
JTU = Jackson Turbidity Units
na = not applicable

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

Bob Brakke

Laboratory Manager

Charter Memb

APPENDIX D - TABULATION OF GRAZING LEASES ON STATE LAND SURROUNDING T.1N., R.37E., SECTION 36

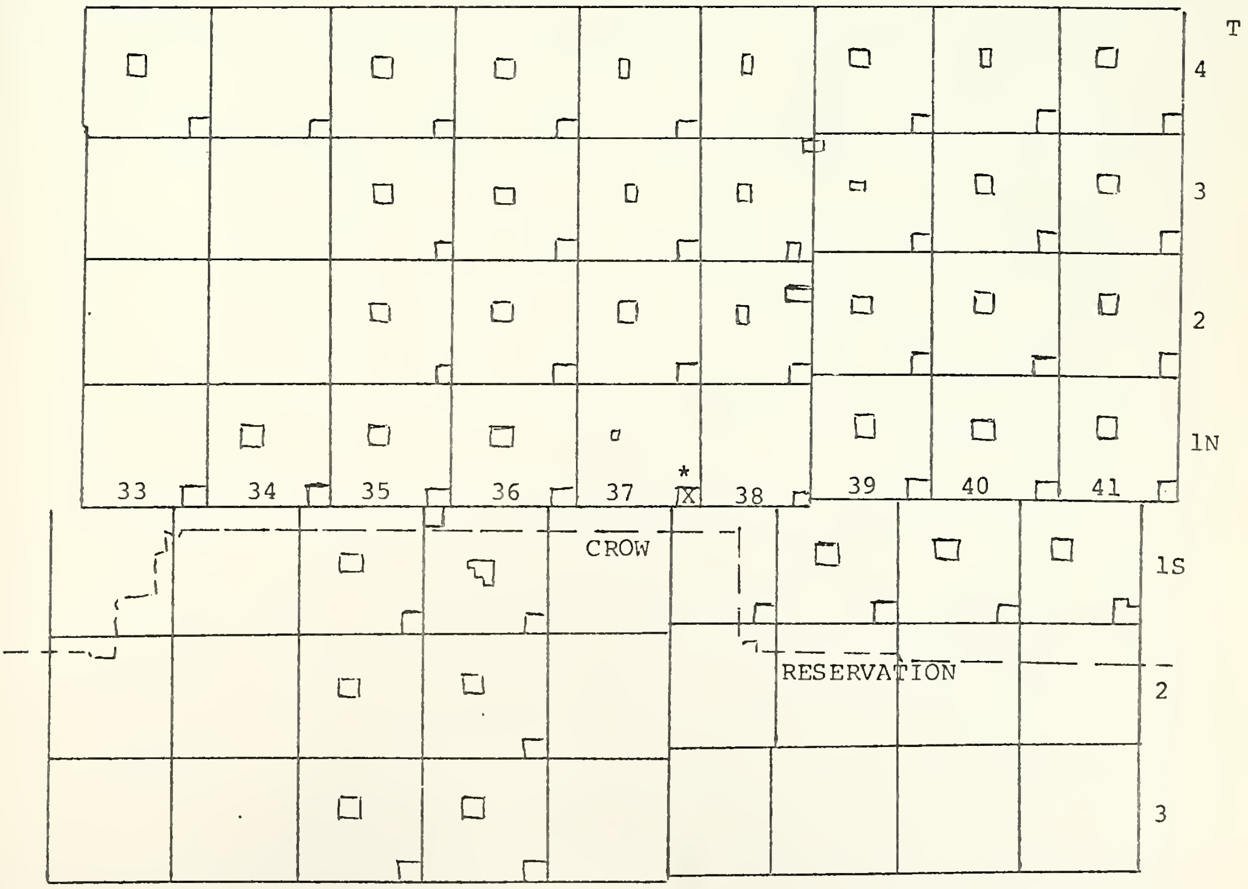
TABULATION OF GRAZING LEASES
ON STATE LAND SURROUNDING T1N R37E Sec. 36*

Location		Acres	AUM	Au. AUM/ac			Source of Water	File #
T1N R33E Sec.	36	640	132	.21				6845
34	16	640	192	.3			Spring	6024
	36	640	132	.21				6681
35	16	640	156	.24				6681
	36	640	?	545 AC			Creek	4289
36	16	640	180	.28			Creek	8258
	36	640	168	.27			Spring	52808
37	16	160	51	.32				1361
	*36	640	240	.38			Springs	4093
38	-36	120	38	.32				519
	16	383.8	115	.3			Spring	3576
39	16	320	60	.19				4877
	36	640	132	.21				7445
40	16	640	180	.3				3326
	36	640	170	.28				7444
41	16	640	144	.225				792
	36	640	108	.17				7443
T2N R35E Sec.	16	640	144	.225				1366
	36	480	108	.225			Creek	1336
36	16	640	192	.3				2538
	36	640	140	.22			Spring	8393
37	16	640	192	.3				8106
	36	640	168	.27				1365
38	12	320	78	.24				2155
	16	316.7	83	.26			Dam	2051
	36	640	144	.225			Dam	2156
39	16	640	180	.28				4468
	18	320	78	.24				2052
	36	633.3	178	.28				5230
40	16	640	168	.27				5634
	36	640	180	.3				2053
41	16	603.8	204	.34				2054
	36	640	204	.32				824
T3N R35E Sec.	16	640	144	.225			Spring	3687
	36	320	66	.21				1107
36	16	640	156	.24				3688
	36	640	144	.225				2157
57	16	320	72	.225				2158
	36	640	168	.27			Dam	2159
38	16	274.9	72	.26				3689
	36	320	60	.19				5841
39	16	320	96	.3				782
	36	687.8	206	.3				756
40	16	640	108	.17				7441
	36	640	192	.3				2054
41	16	640	168	.27				748
	36	640	168	.27			Creek	4942
T4N R33E Sec.	16	640	144	.225				7687
	17	200	60	.3				2354
	36	640	108	.17				2214
34	36	640	132	.21				4249

Location		Acres	AUM	Au. AUM/ac			Source of Water	File #
35	16	640	144	.225			Creek	5931
	36	640	156	.24				7715
36	16	640	128	.2				2160
	36	640	168	.27				4597
37	16	320	72	.225				983
	36	640	144	.225				4540
38	16	283.1	64	.225				4540
39	16	640	192	.3				788
	36	667.6	188	.28				783
40	16	320	84	.26				764
	36	640	144	.225				3328
41	16	640	168	.27				794
	36	640	96	.15				7440
T1S R35E Sec.	16	640	168	.27				2891
	36	640	180	.28				2891
36	16	360	101	.28			Creek	1367
	36	640	156	.24				7924
38	36	640	216	.34			Spring	433
39	16	640	180	.28			Dam	4288
	36	640	168	.27				750
40	16	640	168	.27				7902
	36	636.8	155	.24				2075
41	16	640	216	.34				7281
	36	640	192	.3				793
T2S R35E Sec.	16	640	180	.28				2890
36	16	640	192	.3			Dam	2890
	36	640	192	.3				6384
T3S R35E Sec.	16	640	168	.27				6394
	36	640	204	.32			Dam	6394
36	16	640	156	.24				6394

TOTAL: 45,771.4 acres State Land

ARRANGEMENT OF STATE LANDS
SURROUNDING
T1N R37E Sec. 36*



APPENDIX E - VEGETATION COMMUNITY TYPES AND SPECIES LIST (WESTMORELAND RESOURCES, 1976b)

SILTY (Si)

The silty community type is the grassland community developing on loamy soils, and is synonymous with the silty range site. In the study area, the Si plant community is associated with Fort Collins, Cushman, Chugter, Thedalund and Spearman loams. Transects 36-SP-1, 3 and 6 (Table 1) were located in areas of the Si plant community within Section 36, which had been heavily grazed. Condition ratings varied from 46 to 55, or from high fair to low good. Canopy coverage transect 36-CC-3 (Table 2) was in an area protected from grazing since 1973 in the southwest quarter of Section 25; heavy grazing in the past was indicated by a condition rating of 50. All four areas were dominated by western wheatgrass, needle and thread and/or prairie junegrass in various orders of importance. Green needlegrass, an important decreaser in this community, was significant only in Transects 36-SP-3 and 36-CC-3. A silty site with an apparent excellent condition rating could not be located within the study area. Despite its relatively low occurrence in the samples, green needlegrass should be considered to be of functional importance in this type. Therefore, in terms of dominant species, the Si type can be described as a green needlegrass-western wheatgrass-needle and thread-prairie junegrass type.

Observations indicated that drainage characteristics may influence relative dominance of the various species, with western wheatgrass reaching its greatest development on lower slopes and flats with more favorable moisture conditions, and needle and thread predominating in drier areas.

Penn sedge appeared to be an important increaser in grazed areas. Its importance was greatly magnified by the method employed to measure species composition in that its density was quite high, but the plants were small and contributed little to canopy coverage and biomass production. Penn sedge was not encountered in Transect 36-CC-3, possibly as a result of protection from grazing in recent years.

Invader species of importance on silty sites were red threeawn, bluegrasses, primarily Kentucky bluegrass, and annual bromes (cheatgrass). Red threeawn and annual bromes were encountered most often on the better drained sites, while bluegrasses were usually associated with more favorable moisture conditions. It is probable that due to the late August sampling, annual bromes and bluegrasses were somewhat under-represented in the samples.

Two subtypes of the silty type were classified on the basis of shrub dominance.

Silty - Silver Sagebrush (Si-1)

Silver sagebrush occurred primarily on lower slopes and flats. Its development appeared to be related to favorable moisture conditions, but preference for such areas by cattle may also have been a factor. Transects 36-SP-8 and 10 (Table 1) were in the Si-2 type. In Transect 36-SP-8, western wheatgrass and blue grama were the dominant grass species, while in Transect 36-SP-10, bluegrasses and western wheatgrass were dominant. The condition rating of Transect 36-SP-8 was 55; 36-SP-10 had a condition rating of only 35.

Needle and thread generally was not encountered in the Si-1 subtype, and is not included as a dominant species. It is replaced by blue grama which based on the samples, is an important increaser. Therefore, Si-1 is given the designation green needlegrass-western wheatgrass-prairie junegrass-blue grama-silver sagebrush.

Silty-Silver Sagebrush-Snowberry (Si-2)

The silty-silver sagebrush-snowberry type represents an ecotone between the silty-silver sagebrush type and the snowberry (UR-1) type, which was classified as a riparian type. It was not sampled. Associated grass species are the same as Si-1.

Sandy (Sy)

The sandy (Sy) community type is the grassland plant community developing on fine sandy loam soils, and is synonymous with the sandy range site. It occurred on the Nelson and Alice fine sandy loam soils. Transects 36-SP-2 (Table 1) and 36-CC-2 (Table 2) were run on the same line. Dominant decreaser species were little bluestem, prairie sandreed and side-oats grama. Needle and thread, prairie junegrass and penn sedge were the major increasers present. The type designation based on dominants is little bluestem-prairie sandreed-side-oats grama-needle and thread. Range condition ratings were 78 based on species composition and 70 based on canopy coverage. Most Sy communities were in good to excellent condition, although condition appeared to be quite reduced in areas near water. In the study area, the Sy type occurred primarily on ridges and upper slopes which appeared to be less utilized by cattle, accounting for the high condition rating.

WETLAND (WL)

Wetland communities occur in areas which are inundated during part of the growing season. Two such areas together comprising less than an acre were identified in the west central portion of Section 36 immediately below intermittent springs. Sedges (Carex sp.) rushes (Juncus sp.) were the dominants. The wetland community was not sampled due to its limited extent.

THIN BREAKS (TB)

In the study area, the TB type occurred on steep, south facing slopes with Wibaux stony loam soils. It occurred as an inclusion within Thedalund-Wibaux stony loams mapping units, which have a thin hilly range site interpretation. The TB type is synonymous with the thin breaks range site.

Thin Breaks - Skunkbush (TB-1)

Transects 36-SP-13 (Table 1) and 36-CC-4 (Table 2) were run on the same line in a TB-1 mapping unit. Skunkbush was a dominant shrub; the primary associated grass species were side-oats grama and bluebunch wheatgrass. Annual brome, an invader, also was present. The type designation is skunkbush-side-oats grama-bluebunch wheatgrass. Range condition was rated at 85 based on species composition and 50 based on canopy coverage. The low condition rating based on canopy coverage resulted from high coverage by annual brome.

Thin Breaks - Skunkbush - Ponderosa Pine (TB-2)

The skunkbush-ponderosa pine type occurred on somewhat less severe slopes than TB-1, and was essentially a TB-1 community with an open canopy ponderosa pine overstory. Transect 36-SP-11 (Table 1) was run in a TB-2 community; side-oats grama and bluebunch wheatgrass were the dominant grass species. The TB-2 community appeared to be an ecotone between the TB-1 and open canopy ponderosa pine (PP-2) types.

PONDEROSA PINE (PP)

Ponderosa pine types were classified on the basis of canopy coverage classes and associated species. Five species composition transects (36-SP-4, 5, 7, 11 and 12; Table 1) were located on a variety of soils, slopes and exposures in an effort to detect differences in herbaceous plant communities. Although relative dominance of species varied, all but one sample could be classified as ponderosa pine-bluebunch wheatgrass-side-oats grama-Idaho fescue. Transect 36-SP-11 was classified as a thin breaks (TB) subtype due to the importance of skunkbush and the absence of Idaho fescue. Ponderosa pine reaches its greatest development on north-facing slopes, most often on Wibaux stony loam soils, but occasionally also on Nelson and Alice fine sandy loams and on Thedalund loam. Following are discussions of the various ponderosa pine subtypes:

Ponderosa Pine Closed Canopy (PP-1)

Ponderosa pine stands with greater than about 80 percent canopy coverage as estimated by examining aerial photographs were included in this type. Closed canopy stands in most cases were "doghair" thickets with dense growth of small trees. Timber transects 36-T-3 and 4 (Table 3) describe closed canopy "doghair" stands in Section 36. Both transects were on Wibaux stony loam soils with north exposures. Densities were quite high, with 842 and 1252 trees per acre, respectively, and the majority of trees below four inches DBH. Transect 36-CC-6 describes the ground cover in a closed canopy pine stand. Cover was sparse with only 24 percent vegetative coverage. Idaho fescue, side-oats grama and bluebunch wheatgrass were dominants as expected.

Ponderosa Pine Open Canopy (PP-2)

Open canopy pine stands, or stands with canopy coverage in the range of 40-80 percent, constituted the majority of pine stands in the study area. These stands were generally open and park-like with a medium density grass understory. Timber transects 36-T-1, 2 and 3 (Table 3) describe PP-2 stands. The number of trees per acre ranged from 124 to 166 with relatively few individuals less than four inches DBH. In all three stands, the majority of trees were in the range of four to 14 inches DBH.

Species composition transects 36-SP-4, 5, 7, and 12 (Table 1) were in PP-2 stands; Transect 36-CC-1 (Table 2) was run on the same line as 36-SP-5. Although the results of the transects varied, Idaho fescue, side-oats grama and bluebunch wheatgrass were consistent associated grass species. Skunkbush and snowberry were common understory shrubs. Range condition varied from 45 to 77, placing the type generally in the good condition class. In many areas, particularly on the Thedalund-Wibaux complex (736D on the Westmoreland Resources soils map), the PP-2 type may have small inclusions of PP-1, PP-3, TB-1 and/or TB-2 depending upon soils, topography, slope and aspect.

Ponderosa Pine Savannah (PP-3)

The ponderosa pine savannah type is an ecotone between PP-2 and grassland types, with ponderosa pine presence consisting of scattered individuals with canopy coverage less than about 40 percent. In many cases this type has developed on Nelson and Alice fine sandy loam soils, and the grassland component is typical of the Sy community type. Such areas are indicated on the vegetation map as PP-3-Sy. Within the Thedalund-Wibaux complex, the type often occurs on lower slopes, ridge tops or undulating topography with the grassland component a complex of Sy and Si types depending on local soil characteristics. Areas influenced by the presence of ponderosa pine are typical of the PP-2 type, with characteristic grass associates.

Transects 36-SP-14 (Table 1) and 36-CC-5 (Table 2) were run on the same line on a ridge top classified as PP-3. The grassland component of this particular stand was more typical of sandy than a silty site, with little bluestem and prairie sandreed the dominant species. Bluebunch wheatgrass and Idaho fescue also were present reflecting the influence of the ponderosa pine. Range condition was calculated to be 81 based on canopy coverage and 82 based on species composition.

Ponderosa Pine Snowberry (PP-4)

The ponderosa pine-snowberry type is an ecotone between ponderosa pine, usually PP-1 or PP-2, and the UR-1 or snowberry type, and consists of ponderosa pine with a snowberry understory. This type usually occurs in drainageways within ponderosa pine stands, and occasionally along steep-walled coulees within grassland types where localized soil conditions are conducive to the development of ponderosa pine. Associated grass species are those normally associated with the ponderosa pine and/or snowberry types. The PP-4 type was not sampled.

UPLAND RIPARIAN (UR)

Upland riparian types are deciduous shrub and tree communities which have developed along intermittent drainageways.

Snowberry (UR-1)

The snowberry type consists primarily of a dense growth of snowberry. Wood's rose may reach considerable importance in some stands. The most commonly associated grass species is Kentucky bluegrass, an invader. Transect 36-SP-9 (Table 1) was in the UR-1 type; besides bluegrasses, western wheatgrass and big bluestem were important grass species. The presence of big bluestem probably indicates localized overflow conditions. The snowberry appears to represent a silty or overflow range site in extremely reduced condition. The condition rating of the sample transect was only 33 ignoring the snowberry. Since snowberry coverage was in excess of 75 percent, the corrected range condition would be less than 10, or very poor.

Shrub Thickets (UR-2)

This type is dominated by hawthorn, choke cherry and wild plum in widely varying order of dominance. Usually these stands had an understory of snowberry and Wood's rose. Samples UR-2 (1, 2 and 3) (Table 4) demonstrate the variability of these stands. In the study area, hawthorn was usually the dominant species.

Ash Coulee (UR-3)

The ash coulee type is essentially the UR-2 type with an overstory of green ash. The only UR-3 mapping unit in the study was in a deep gully with ponderosa pine along the rims. Oregon grape was a common understory plant. Sample UR-3 (1) (Table 4) describes the composition of this mapping unit.

AGRICULTURAL (Ag)

Agricultural types are those associated with present or past farming activities.

Grass Hay (Ag-1)

The only agricultural type in the study area was a grass hayfield in Section 35. This field appeared to be a mixture of domestic wheatgrasses.

Common and Latin Plant Names

Grasses and Grass-like Plants

Decreasers:

Big bluestem	*Andropogon gerardi*
Bluebunch wheatgrass	*Agropyron spicatum*
Green needlegrass	*Stipa viridula*
Indian ricegrass	*Oryzopsis hymenoides*
Little bluestem	*Andropogon scoparius*
Prairie sandreed	*Calimovilfa longifolia*
Sedge (WL type)	*Carex* spp.
Side-oats grama	*Bouteloua curtipendula*

Increasers:

Blue grama	*Bouteloua gracilis*
Idaho fescue	*Festuca idahoensis*
Needle and thread	*Stipa comata*
Penn sedge	*Carex pensylvanicum*
Prairie junegrass	*Koeleria cristata*
Rush	*Juncus* spp.
Thickspike wheatgrass	*Agropyron dasystachyum*
Western wheatgrass	*Agropyron smithii*

Invaders:

Annual brome	*Bromus* spp.
Bluegrass	*Poa* spp.
Kentucky bluegrass	*Poa pratensis*
Red threeawn	*Aristida longiseta*
Threadleaf sedge	*Carex filifolia*

Forbs and Halfshrubs

Annual sowthistle	*Sonchus asper*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Aster	*Aster* spp.
Broom snakeweed	*Gutierrezia sarothrae*
Clover	*Petalostemon* spp.
Dandelion	*Taraxacum officinale*
Dotted gayfeather	*Liatris punctata*
Fringed sage	*Artemisia frigida*
Goat's beard	*Tragopogon dubius*
Golden aster	*Chrysopsis villosa*
Goldenrod	*Solidago* spp.
Green sagewort	*Artemisia dracunculus*
Hood's phlox	*Phlox hoodii*
Mariposa lily	*Calochortus nuttallii*
Milkvetch	*Astragalus* spp.
Oregon grape	*Mahonia repens*
Prairie chickweed	*Cerastrium arvense*
Prairie coneflower	*Ratibida columnifera*
Prostrate knotweed	*Polygonum aviculare*
Pussytoes	*Antennaria* spp.
Scarlet globe mallow	*Sphaeralcea coccinea*

Silverleaf scurfpea	*Psoralea argophylla*
Slimflower scurfpea	*Psoralea tenuiflora*
Thistle	*Cirsium undulatum*
Western ragweed	*Ambrosia artemisifolia*
White sagewort	*Artemisia ludoviciana*
Wild lettuce	*Lactuca pulchella*
Yarrow	*Achillea millefolium*

Shrubs and Trees

Box elder	*Acer negundo*
Choke cherry	*Prunus virginiana*
Green ash	*Fraxinus pennsylvanica*
Hawthorn	*Crataegus* spp.
Juniper	*Juniperus* spp.
Ponderosa pine	*Pinus ponderosa*
Prairie rose	*Rosa arkansana*
Silver sagebrush	*Artemisia cana*
Wild currant	*Ribes* spp.
Wild plum	*Prunus americana*
Willow	*Salix* spp.
Wood's rose	*Rosa woodsii*
Yucca	*Yucca glauca*

APPENDIX F - LIST OF BIRDS AND MAMMALS THAT OCCUR OR POTENTIALLY OCCUR ON TRACT II AND TRACT III, SARPY CREEK, BIG HORN COUNTY, MONTANA

(WESTMORELAND RESOURCES, 1975f)

APPENDIX F

LIST OF BIRDS THAT OCCUR OR POTENTIALLY OCCUR ON TRACT II AND TRACT III SARPY CREEK, BIGHORN COUNTY, MONTANA

	Family Gavidae	- Loons
	Common Loon	- Gavia immer
	Family Podicipedidae	- Grebes
	Horned Grebe	- Podiceps auritus
	Eared Grebe	- Podiceps nigricollis
	Western Grebe	- Aechmophorus occidentalis
	Pied-billed Grebe	- Podilymbus podiceps
	Family Pelecanidae	- Pelicans
	White Pelican	- Pelecanus erythrorhynchos
	Family Phalacrocorracidae	- Cormorants
	Double-crested Cormorant	- Phalacrocrorax auritus
	Family Ardeidae	- Herons and Bitterns
	Great Blue Heron	- Ardea herodias
	Black-crowned Night Heron	- Nycticorax nycticorax
	American Bittern	- Botaurus Lentiginosus
	Family Anatidae	- Swans, Geese, and Ducks
	Canada Goose	- Branta canadensis
	White-fronted Goose	- Anser albifrons
	Snow Goose	- Chen caerulescens
x	Mallard	- Anas platyrhynchos
	Gadwall	- Anas strepera
	Pintail	- Anas acuta
x	Green-winged Teal	- Anas crecca
x	Blue-winged Teal	- Anas discors
	Cinnamon Teal	- Anas cyanoptera
	American Wigeon	- Anas americana
S x	Shoveler	- Anas clypeata
	Redhead	- Aythya americana
	Ring-necked Duck	- Aythya collaris
	Canvasback	- Aythya valisineria
	Greater Scaup	- Aythya marila
	Lesser Scaup	- Aythya affinis
	Common Goldeneye	- Bucephala clangula
	Bufflehead	- Bucephala albeola
	Ruddy Duck	- Oxyura jamaicensis
	Hooded Merganser	- Lophodytes cucullatus
	Common Merganser	- Mergus merganser
	Red-breasted Merganser	- Mergus serrator

	Family Cathartidae	American Vultures
	Turkey Vulture	*Cathartes aura*
	Family Accipitridae	Kites, Hawks, Eagles, and Harriers
s	Goshawk	*Accipiter gentilis*
s	Sharp-shinned Hawk	*Accipiter striatus*
s	Cooper's Hawk	*Accipiter cooperii*
x	Red-tailed Hawk	*Buteo jamaicensis*
x	Swainson's Hawk	*Buteo swainsoni*
x	Rough-legged Hawk	*Buteo lagopus*
	Ferruginous Hawk	*Buteo regalis*
xs	Golden Eagle	*Aquila chrysaetos*
	Bald Eagle	*Haliaeetus leucocephalus*
xs	Marsh Hawk	*Circus cysneus*
	Family Pandionidae	Ospreys
s	Osprey	*Pandion haliaetus*
	Family Falconidae	Caracaras and Falcons
xs	Prairie Falcon	*Falco mexicanus*
s	Peregrine Falcon	*Falco peregrinus*
s	Pigeon Hawk	*Falco columbarius*
x	Sparrow Hawk	*Falco sparverius*
	Family Tetraonidae	Grouse and Ptarmigan
x	Sharp-tailed Grouse	*Pedioecetes phasianellus*
	Sage Grouse	*Centrocercus urophasianus*
	Family Phasianidae	Quail, Pheasants, and Partridge
x	Ring-necked Pheasant	*Phasianus colchicus*
x	Gray Partridge	*Perdix perdix*
	Family Meleagrididae	Turkeys
x	Turkey	*Meleagris gallopavo*
	Family Gruidae	Cranes
	Sandhill Crane	*Grus canadensis*
	Family Rallidae	Rails, Gallinules, and Coots
	Sora	*Porzana carolina*
	Yellow Rail	*Coturnicops noveboracensis*
x	American Coot	*Fulica americana*
	Family Charadriidae	Plovers, Turnstones, and Surfbirds
	Semipalmated Plover	*Charadrius semipalmatus*
x	Killdeer	*Charadrius vociferus*
s	Mountain Plover	*Charadrius montanus*
	Black-bellied Plover	*Pluvialis squatarola*

	Family Scolopacidae	- Woodcock, Snipe, and Sandpipers
x	Common Snipe	- *Capella gallinago*
	Long-billed Curlew	- *Numeninus americanus*
x	Upland Plover	- *Bartramis longicauda*
x	Spotted Sandpiper	- *Actitis macularia*
	Solitary Sandpiper	- *Tringa solitaria*
	Greater Yellowlegs	- *Tringa melanoleuca*
	Lesser Yellowlegs	- *Tringa flavipes*
	Willet	- *Catoptrophorus semipalmatus*
	Pectoral Sandpiper	- *Calidris melanotos*
	White-rumped Sandpiper	- *Calidris fuscicollis*
	Baird's Sandpiper	- *Calidris bairdii*
	Least Sandpiper	- *Calidris minutilla*
s	Semipalmated Sandpiper	- *Calidris pusilla*
s	Western Sandpiper	- *Calidris mauri*
s	Sanderling	- *Calidris alba*
x	Long-billed Dowitcher	- *Limnodromus scolopaceus*
	Stilt Sandpiper	- *Micropalama himantopus*
	Buff-breasted Sandpiper	- *Tryngites subruficollis*
	Marbled Godwit	- *Limosa fedoa*
	Hudsonian Godwit	- *Limosa haemastica*
	Family Recurvirostridae	- Avocets and Stilts
	American Avocet	- *Recurvirostra americana*
	Family Phalaropodidae	- Phalaropes
	Wilson's Phalarope	- *Steganopus tricolor*
	Family Laridae	- Gulls and Terns
s	Herring Gull	- *Larus argentatus*
	California Gull	- *Larus claifornicus*
	Ring-billed Gull	- *Larus delawarensis*
	Franklin's Gull	- *Larus pipixcan*
s	Bonaparte's Gull	- *Larus philadelphia*
	Forster's Tern	- *Sterna forsteri*
s	Caspian Tern	- *Hydroprogne caspia*
	Black Tern	- *Chlidonias niger*
	Family Columbidae	- Pigeons and Doves
x	Rock Dove	- *Columba livia*
x	Mourning Dove	- *Zenaida macroura*
	Family Cuculidae	- Cuckoos, Roadrunners, and Antis
xs	Yellow-billed Cuckoo	- *Coccyzus americanus*
	Blacked-billed Cuckoo	- *Coccyzus erythropthalmus*
	Family Strigidae	- Typical Owls
s	Screech Owl	- *Otus asio*
x	Great Horned Owl	- *Bubo virginianus*
s	Burrowing Owl	- *Speotyto cunicularia*
	Barred Owl	- *Strix varia*

s	Long-eared Owl	*Asio otus*
	Short-eared Owl	*Asio flammeus*
xs	Saw-whet Owl	*Aegolius acadicus*
	Snowy Owl	*Nyctea scandiaca*
	Family Caprimulgidae	Goatsuckers
	Poor-will	*Phalaenoptilus nuttallii*
x	Common Nighhawk	*Chordeiles minor*
	Family Apodidae	Swifts
	White-throated Swift	*Aeronautes saxatalis*
	Family Trochilidae	Hummingbirds
	Ruby-throated Hummingbird	*Archilochus colubris*
	Black-chinned Hummingbird	*Archilochus alexandri*
	Rufous Hummingbird	*Selasphorus rufus*
	Family Alcedinidae	Kingfishers
x	Belted Kingfisher	*Megaceryle alcyon*
	Family Picidae	Woodpeckers, Flickers, and Sapsuckers
x	Common Flicker	*Colaptes auratus*
x	Red-headed Woodpecker	*Melanerpes erythrocephalus*
	Yellow-bellied Sapsucker	*Sphyrapicus varius*
s	Williamson's Sapsucker	*Sphyrapicus thyroideus*
x	Hairy Woodpecker	*Dendrocopos villosus*
	Downy Woodpecker	*Dendrocopos pubescens*
	Family Tyrannidae	Tyrant Flycatchers
x	Eastern Kingbird	*Tyrannus tyrannus*
xs	Western Kingbird	*Tyrannus verticalis*
	Eastern Phoebe	*Sayornis phoebe*
x	Say's Phoebe	*Sayornis saya*
	Willow Flycatcher	*Empidonax traillii*
	Least Flycatcher	*Empidonax minimus*
	Western Flycatcher	*Empidonax difficilis*
x	Western Wood Pewee	*Contopus sordidulus*
	Olive-sided Flycatcher	*Nuttallornis borcalis*
	Family Alaudidae	Larks
	Horned Lark	*Eremophila alpestris*
	Family Hirundinidae	Swallows
x	Violet-green Swallow	*Tachycineta thalassina*
x	Bank Swallow	*Riparia riparia*
x	Rough-winged Swallow	*Stelgidopteryx ruficollis*
x	Barn Swallow	*Hirundo rustica*
x	Cliff Swallow	*Petrochelidon pyrrhonota*
s	Purple Martin	*Progne subis*

Family Corvidae - Jays, Magpies, and Crows
Gray Jay - *Perisoreus canadensis*
x Black-billed Magpie - *Pica pica*
x Common Cow - *Corvus brachyrhynchos*
x Pinyon Jay - *Gymnorhinus cyanocephalus*
Clark's Nutcracker - *Nucifraga columbiana*

Family Paridae - Chickadees, Titmice, Verdins, and Bushtits
x Black-capped Chickadee - *Parus atricapillus*

Family Sittidae - Nuthatches
x White-breasted Nuthatch - *Sitta carolinensis*
x Red-breasted Nuthatch - *Sitta canadensis*

Family Certhiidae - Creepers
Brown Creeper - *Certhia familiaris*

Family Cinclidae - Dippers
Dipper (water ouze) - *Cinclus mexicanus*

Family Troglodytidae - Wrens
x House Wren - *Troglodytes aedon*
Long-billed Marsh Wren - *Telmatodytes palustris*
Rock Wren - *Salpinctes obsoletus*

Family Mimidae - Mockingbirds and Thrashers
Catbird - *Dumetella carolinensis*
x Brown Thrasher - *Toxostoma rufum*
Sage Thrasher - *Oreoscoptes montanus*

Family Turdidae - Thrushes, Solitaires, and Bluebirds
x American Robin - *Turdus migratorius*
Wood Thrush - *Hylocichla mustelina*
Swainson's Thrush - *Catharus ustulatus*
Gray-cheeked Thrush - *Catharus minimus*
Veery - *Catharus fuscescens*
s Eastern Bluebird - *Sialia sialis*
x Mountain Bluebird - *Sialia currucoides*
Townsend's Solitaire - *Myadestes townsendi*

Family Sylviidae - Arctic Warblers, Kinglets, Gnatcatchers
Golden-crowned Kinglet - *Regulus satrapa*
Ruby-crowned Kinglet - *Regulus calenpula*

Family Motacillidae - Wagtails and Pipits
Water Pipit - *Anthus spinoletta*
Sprague's Pipit - *Anthus spragueii*

	Family Bombycillidae	Waxwings
	Bohemian Waxwing	*Bombycilla garrulus*
	Cedar Waxwing	*Bombycilla cedrorum*
	Family Laniidae	Shrikes
	Northern Shrike	*Lanius excubitor*
x	Loggerhead Shrike	*Lanius ludovicianus*
	Family Sturnidae	Starlings
x	Starling	*Sturnus vulgaris*
	Family Vireonidae	Vireos
x	Solitary Vireo	*Vireo solitarius*
	Red-eyed Vireo	*Vireo olivaceus*
	Warbling Vireo	*Vireo gilvus*
	Family Parulidae	Wood Warblers
s	Black-and-white Warbler	*Mniotilta varia*
s	Tennessee Warbler	*Vermivora peregrina*
	Orange-crowned Warbler	*Vermivora celata*
x	Yellow Warbler	*Dendroica petechia*
	Magnolia Warbler	*Dendroica magnolia*
x	Yellow-rumped Warbler	*Dendroica coronata*
	Townsend's Warbler	*Dendroica townsendi*
	Black-throated Green Warbler	*Dendroica virens*
	Chestnut-sided Warbler	*Dendroica pensylvanica*
	Blackpoll Warbler	*Dendroica striata*
	Palm Warbler	*Dendroica palmarum*
	Ovenbird	*Seiurus aurocapillus*
	Northern Waterthrush	*Seiurus noveboracensis*
	MacGillivrav's Warbler	*Oporornis tolmiei*
	Yellowthroat	*Geothylpis trichas*
	Yellow-breasted Chat	*Icteria virens*
x	Wilson's Warbler	*Wilsonia pusilla*
	American Redstart	*Setophaga ruticilla*
	Family Ploceidae	Weaver Finches
x	House Sparrow	*Passer domesticus*
	Family Icteridae	Meadowlarks, Blackbirds, and Orioles
	Bobolink	*Dolichonyx oryzivorus*
x	Western Meadowlark	*Sturnella neglecta*
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
x	Red-winged Blackbird	*Agelaius phoeniceus*
s	Orchard Oriole	*Icterus spurius*
x	Northern Oriole	*Icterus galbula*
x	Brewer's Blackbird	*Euphagus cyanocephalus*
x	Common Grackle	*Ouiscalus quiscula*
x	Brown-headed Cowbird	*Molothrus ater*

Family Thraupidae - Tanagers
Western Tanager - *Piranga ludoviciana*

Family Fringillidae - Grosbeaks, Sparrows, Finches and Buntings
Lazuli Bunting - *Passerina amoena*
s Dickcissel - *Spiza americana*
Evening Grosbeak - *Hexperiphona vespertina*
Purple Finch - *Carpodacus purpureus*
House Finch - *Carpodacus mexicanus*
Pine Grosbeak - *Pinicola enucleator*
Gray-crowned Rosy Finch - *Leucosticte tephrocotis*
Black Rosy Finch - *Leucosticte atrata*
Common Redpoll - *Acanthis flammea*
x Pine Siskin - *Spinus pinus*
x American Goldfinch - *Spinus tristis*
x Red Crossbill - *Loxia curvirostra*
Green-tailed Towhee - *Chlorura chlorura*
x Rufous-sided Towhee - *Pipilo erythrophthalmus*
x Lark Bunting - *Calamospiza melanocorys*
x Savannah Sparrow - *Passerculus sandwichensis*
Grasshopper Sparrow - *Ammodramus savannarum*
Baird's Sparrow - *Ammodramus bairdii*
Sharp-tailed Sparrow - *Ammospiza caudacuta*
x Vesper Sparrow - *Pooecetes gramineus*
x Lark Sparrow - *Chondestes grammacus*
Dark-eyed Junco - *Junco hyemalis*
Tree Sparrow - *Spizella arborea*
x Chipping Sparrow - *Spizella passerina*
Clay-colored Sparrow - *Spizella pallida*
x Brewer's Sparrow - *Spizella breweri*
s Field Sparrow - *Spizella pusilla*
Harris's Sparrow - *Zonotrichia querula*
White-crowned Sparrow - *Zonotrichia leucophrys*
White-throated Sparrow - *Zonotrichia albicollis*
Fox Sparrow - *Passerella iliaca*
Lincoln's Sparrow - *Melospiza lincolnii*
Song Sparrow - *Melospiza melodia*
McCown's Longspur - *Calcarius mccownii*
Lapland Longspur - *Calcarius lapponicus*
Smith's Longspur - *Calcarius pictus*
Chestnut-collared Longspur - *Calcarius ornatus*
Snow Bunting - *Plectrophenax nivalis*

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x - Observed on area (Westmoreland Resources, 1975f)

s - Birds of special interest (Westmoreland Resources, 1975f)

SPECIES OF MAMMALS OBSERVED OR POSSIBLY OCCURING IN SARPY BASIN, BIG HORN COUNTY, MONTANA.*

Family Soricidae - Shrews

Masked Shrew - *Sorex cinereus*
Merriams Shrew - *Sorex merriami*

Family Vespertilionidae - Plainnose Bats

Little Brown Bat - *Myotis lucifugus*
Long-Eared Bat - *Myotis evotis*
Yuma Bat - *Myotis yumanensis*
Long-legged Bat - *Myotis volans*
Masked, or Least Bat - *Myotis leibii*
Hoary Bat - *Lasiurus cinereus*
Silver-haired Bat - *Lasionycteris noctivagans*
Spotted Bat - *Euderma maculatum*
Big Brown Bat - *Eptesicus fuscus*
Red Bat - *Lasiurus borealis*
Western Big-eared Bat - *Plecotus townsendii*

Family Procyonidae - Raccoons and Coatis

x Raccoon - *Procyon lotor*

Family Mustelidae - Weasels, Skunks, and Allies

Long-tailed Weasel - *Mustela frenata*
Mink - *Mustela vison*
Black-footed Ferret - *Mustela nigripes*
Western Spotted Skunk - *Spilogale gracilis*
x Striped Skunk - *Mephitis mephitis*
Badger - *Taxidea tarus*

Family Canidae - Dogs, Wolves, and Foxes

x Coyote - *canis latrans*
Swift fox - *Vulpes velox*
Red fox - *Vulpes fulva*

Family Felidae - Cats

x Bobcat - *Lynx rufus*

Family Sciuridae - Squirrels

Yellow-bellied Marmot - *Marmota flaviventris*
x Black-tailed Prarie Dog - *Cynomys ludovicianus*
Richardson's Ground Squirrel - *Citellus richardsoni*
x Thirteen-lined Ground Squirrel - *Citellus tridecemlineatus*
x Least Chipmunk - *Eutamius minimus*
x Red Squirrel - *Tamiaciurus hudsonicus*

Family Geomyidae - Pocket Gophers

x Northern Pocket Gopher - *Thomomys talpoides*

Family Heteromyidae - Pocket Mice, Kangaroo Mice, and Kangaroo Rats

x Wyoming or Olive-backed Pocket Mouse - *Perognathus Fasciatus*
Ord's Kangaroo Rat - *Dipodmys ordi*

Family Castoridae - Beaver

Beaver - *Castor canadensis*

Family Cricetidae - Mice, Rats, Lemmings and Voles

x Western Harvest Mouse - *Reithrodontonys megalotis*
x Deer Mouse - *Peromyscus maniculatus*
White-footed Mouse - *Peromyscus leucopus*
x Northern Grasshopper Mouse - *Onychomys leucogaster*
Bushy-tailed Woodrat - *Neotoma cinerea*
Meadow Vole - *Microtus pennsylvanicus*
x Prarie Vole - *Microtus ochrogaster*
Long-tailed Vole - *Microtus longicaudus*
Sagebrush Vole - *Lagurus curtatus*
Muskrat - *Ondatra zibethica*

Family Muridae - Old World Rats and Mice

Norway Rat - *Rattus norvegicus*
House Mouse - *Mus musculus*

Family Zapodidae - Jumping Mice

Meadow Jumping Mouse - *Zapus hudsonius*

Family Erethizontidae - Porcupine

x Porcupine - *Erethizon dorsatum*

	Family Leporidae	- Hares and Rabbits
	White-tailed Jack Rabbit	- *Lepus townsendi*
x	Mountain Cottontail	- *Sylvilagus nuttalli*
x	Desert Cottontail	- *Sylvilagus auduboni*
	Family Ceruidae	- Deer
x	White-tailed Deer	- *Odocoileus virginianus*
x	Mule Deer	- *Odocoileus hemionus*
	Family Antilocapridae	- Pronghorn
x	Pronghorn (antelope)	- *Antilocapra americana*

x - denotes animals observed on the area.
* - revised from Westmoreland Resources, 1975 o.

APPENDIX G - ANALYSIS OF GROUNDWATER EFFECTS, PLANNED MINE PITS, SECTION 36, T.1N., R.37E., ABSALOKA MINE BIG HORN COUNTY, MONTANA

Analysis of Ground-Water Effects
Planned Mine Pits, Section 36, T1N, R37E
Absolaka Mine
Big Horn County, Montana

For

WESTMORELAND RESOURCES

By
Dames & Moore
February 18, 1977
6788-017-13

SEATTLE
WHITE PLAINS

DAMES & MOORE
CONSULTANTS IN THE ENVIRONMENTAL AND APPLIED EARTH SCIENCES

VANCOUVER

1620 ALDERSON AVENUE BILLINGS, MONTANA 59102 · (406) 248-2641

February 18, 1977

Mr. David Simpson
Environmental Administrator
Westmoreland Resources
P. O. Box 449
Hardin, Montana 59034

Dear Dave:

Analysis of Ground-Water Effects
Planned Mine Pits, Section 36, T1N, R37E
Absolaka Mine
Big Horn County, Montana

In response to your recent request, we submit the following analysis on the potential ground water inflow into the mine pits to be cut in Section 36, T1N, R37E and the potential effect of the planned mining operations on affected aquifers. The analysis was undertaken by Phil Gagnard, staff hydrogeologist, checked by Tom Wheeler, staff hydrogeologist, and reviewed by Dave Sommers, senior hydrogeologist, all of our Denver office. The estimates of inflow presented in this report should be considered an only approximate values to be used for planning purposes. A more rigorous analysis is necessary to provide inflow estimates for engineering design.

INTRODUCTION

The site specific hydrogeologic data used in our analysis was obtained from our geology and hydrology environmental baseline report prepared for Westmoreland Resources in 1975. Additional data concerning the mining plan for and geologic characteristics of Section 36 were obtained from your prepared application for a state mining permit regarding this section.

Table 1 lists the hydrologic parameters of the water-bearing units considered. The units considered in the analysis were the Rosebud-McKay overburden, Rosebud-McKay coal, the interburden, and the Robinson coal. Alluvium was not considered in our analysis as the geologic cross sections in your mining permit application (Exhibit 7) show that it is absent in the mine area under consideration.

Based on the available data, various assumptions and conditions most probably representative within Section 36, inflow rates of 170 to 220 gallons per minute (gpm) were calculated to occur when the mine pit cut extended to the base of the Robinson coal and north to south for a distance of one mile. Assuming conditions where the hydraulic gradient is 1:1 and high transmissivities occur, maximum inflow calculated was 1,700 to 2,200 gpm. The majority of the inflow is expected from the Rosebud-McKay overburden.

Drawdown of water levels will vary with time and distance from the pit cut and the aquifer affected. For the Rosebud-McKay overburden, the unit with the greatest transmissivity, Figure 1 shows that a drawdown of about 10 feet at a distance 100, 1,000 and 10,000 feet from the pit cut could occur after about 12 days, 3 years and 150 years, respectively. Drawdown rates for this aquifer, and the other affected aquifers, are expected to be considerably less.

A general discussion of our analysis on estimated inflows and effects from mining on water-bearing units follows.

ESTIMATED INFLOWS

Estimates of inflow to the mine pit were calculated from a variation of Darcy's law:

$$Q = KlA$$

Where:

K = Permeability

l = Assumed hydraulic gradient while pit is open

A = Saturated area through which flow occurs

Inflows were calculated assuming that: 1) both the Rosebud-McKay and Robinson coal seams are completely saturated while inflows are occurring; 2) maximum and minimum gradients during inflow are 1:1 and 1:100, respectively; 3) the average permeabilities used are representative of the units considered; 4) all assumptions under Darcy's Law are satisfied; 5) the total length and thickness of a given mine cut is instantaneously open to inflow, and, 6) there is no change in the saturated thickness of the aquifers due to dewatering by gravity drainage.

To estimate the saturated thicknesses of each unit, water levels taken from wells in the vicinity of the mine pit (particularly Well Location 6) were used along with geologic section (E-25 through E-28) in Exhibit 7 of the mining permit application. Ground water in both coal seams is under artesian pressure, therefore, the total thickness of each seam was assumed to contribute to inflow. The saturated thicknesses of the Rosebud-McKay overburden and the interburden were estimated by taking into consideration only the thicknesses of more permeable sands interbedded with clays, siltstones and shales.

Table 2 presents the estimated inflows to the various mine cuts as calculated under the previously listed assumptions. As seen in Table 2, it is estimated that the maximum inflow to an entire cut in the mine could vary from 1,700 to 2,200 gpm depending on the mine cut under consideration. This would be approximately 0.3 - 0.4 gpm per linear foot for the entire thickness of the cut wall. Because the hydraulic gradient is from south to north, inflows from both the east and west walls are assumed to be equal.

The inflows calculated assuming a gradient of 1:10 are probably more representative of the conditions that will likely occur during mining. Thus, inflow rates of 170 to 220 gpm for the entire cut in 0.03 to 0.04 gpm per linear foot of the cut wall would be expected. It is evident from Table 2 that most of the inflow to a mine cut is derived from the Rosebud-McKay overburden and the Rosebud-McKay coal. Based on the permeability data, it is apparent that the Rosebud-McKay overburden will provide the majority of this inflow.

EFFECTS FROM MINING ON WATER-BEARING UNITS

The potential effects of mine dewatering (drainage) on water-bearing units were estimated using the non-leaky artesian drain formula of Knowles (1955) as:

$$s = (720 Q_b X/T) D(u)_q$$

where:

$$D(u)q = \{ (e^{-u^2} / u\sqrt{\pi}) - 1 + (2/\sqrt{\pi}) \} \int_0^{x/2\sqrt{Tt/S}} e^{-u^2} du$$

and

u^2 = $2693X^2S/Tt$

s = drawdown at any point in the vicinity of the drain, in ft.

Q_b = constant discharge (base flow) of the drain, in gpm per lineal foot of drain

X = distance from drain to point of observation, in ft.

t = time after drain started discharging in min.

T = coefficient of transmissivity in gpd/ft

S = coefficient of storage, fraction

Drawdowns at specific distances from the mine cuts were calculated assuming transmissivities of 500 gpd/ft for the Rosebud-McKay overburden, 20 gpd/ft for the interburden plus clinker, 10 gpd/ft for the Rosebud-McKay coal and Robinson coal, an aquifer specific yield of 0.2 for all units and inflows to the mine pit under a gradient of 1:1. Because of the very low T values in the coal, their dewatering contribution to total drawdown will be very small and, as individual units, they are were not considered in this analysis.

For analysis, a theoretical time-drawdown graph (Figure 1) for a drain continuously discharging at a constant discharge (gpm) per linear foot of drain was constructed using the assumed T and S values and matching it with the log-log drain function type curve for non-leaky artesian drains.

Figure 1 shows theoretical time-drawdown curves for a mine cut drain discharging at inflow rates equal to the inflows from the Rosebud-McKay overburden and the interburden. During removal of the overburden in the first 2/5 to 3/5 of all cuts, the drawdown effects in the Rosebud-McKay overburden should follow Curve #1 in Figure 1, showing drawdown at a distance 100 feet from the drain. Curve #2 in Figure 1 shows drawdown in the Rosebud-McKay overburden at a distance of 1,000 feet, and Curve #3 shows drawdown at a distance 10,000 feet from the drain. Curve #2 shows that at a distance of 1,000 feet from the mine cut, the drawdown should be less than 1 foot (negligible) after nearly a year (365 days {5.4×10^5 min}) of dewatering.

Curve #4 on Figure 1 shows that the drawdown effects in the interburden during the lower cuts in the Robinson coal should be less than 1 foot at a distance of 100 feet, approximately 100 days (1.5×10^5 min.) after inflow starts. Because both coal seams have approximately the same transmissivity the drawdown effects in the Rosebud-McKay and Robinson coal seams can be represented by Curve #5. This curve indicates that drawdowns of less than 1 foot at a distance of 100 feet after approximately 140 days (2.0×10^5 min.) of inflow would be the maximum drawdown at this distance.

The drawdowns mentioned above and shown on Figure 1 are maximum effects expected as they are based on calculations using a hydraulic gradient of 1:1. In actuality, drawdowns should be considerably less as the 1:1 gradients (where they exist) will rapidly be reduced on initial draining and become more on the order of between 1:10 and 1:100.

If you should have any questions concerning the contents of this report, please call us at your convenience.

Sincerely yours,

DAMES & MOORE

Ted Rosengreen

Theodore E. Rosengreen, Ph.D.
Project Manager

db

REFERENCES CITED

Dames & Moore, Environmental Baseline Studies for Crow Indian Coal Leases known as Tract II and Tract III, Westmoreland Resources, Sarpy Creek Basin, Big Horn County, Montana, Geology and Hydrology: October 7, 1975.

Knowles, D.B., Ground-Water Hydraulics, U.S. Geological Survey, Ground Water notes; Hydraulics No. 28, open file report, 1955.

Westmoreland Resources, Application for Mining Permit, State of Montana, Section 36, T1N, R37E. 1977.

TABLE I

PERMEABILITIES AND SATURATED THICKNESSES OF AQUIFER UNITS

Water-Bearing Unit	Average[a] Permeability (gpd/ft^2)	Assumed[b] Saturated Thickness (ft)
Rosebud-McKay Overburden	19	20
Rosebud-McKay Coal	0.22	35
Interburden	0.20	40
Robinson Coal	0.22	20

---

[a] Average values of permeability calculated from Table 2.2.3-6 of Environmental Baseline Report (Dames & Moore, 1975).

[b] Assumed saturated thickness taking into consideration static water levels and lithologic changes as indicated in Exhibit 7 of Westmoreland Resources' Application for Mining Permit, 1977.

TABLE 2
CALCULATED RATES OF GROUND-WATER INFLOW TO THE MINE PIT FOR VARIOUS HYDROLOGIC GRADIENTS AND PIT CUTS

Cut No.	Portion	Units[a] Portion	Length of Cut (ft)	Gradient (ft/ft)	Inflow (gpm)	Gradient (ft/ft)	Inflow (gpm)	Gradient (ft/ft)	Inflow (gpm)
1	1st 3/5	RM-OB,RM	3200	1:1	1700-1900	1:10	170-190	1:100	17-19
1[b]	2nd 2/5	INT,RO,C	2000	1:1	≈50	1:10	≈5	1:100	≈1
1[c]	TOTAL	All	5200	1:1	1750-1950	1:10	175-195	1:100	18-20
2[d]	1st 3/5	RM-OB,RM	3400	1:1	1700-2000	1:10	170-200	1:100	17-20
2	2nd 2/5	INT,RO,C	2000	1:1	≈50	1:10	≈5	1:100	≈1
2[c]	TOTAL	ALL	5400	1:1	1750-2050	1:10	175-205	1:100	18-21
3	Entire	INT,RO,C	5500	1:1	100-120	1:10	≈10	1:100	≈1
3[c]	TOTAL	All	5500	1:1	1800-2220	1:10	180-220	1:100	18-22
All Additional Cuts	TOTAL	RM-OB,RM, INT,RO, C	5500	1:1	1800-2220	1:10	180-220	1:100	18-22

---

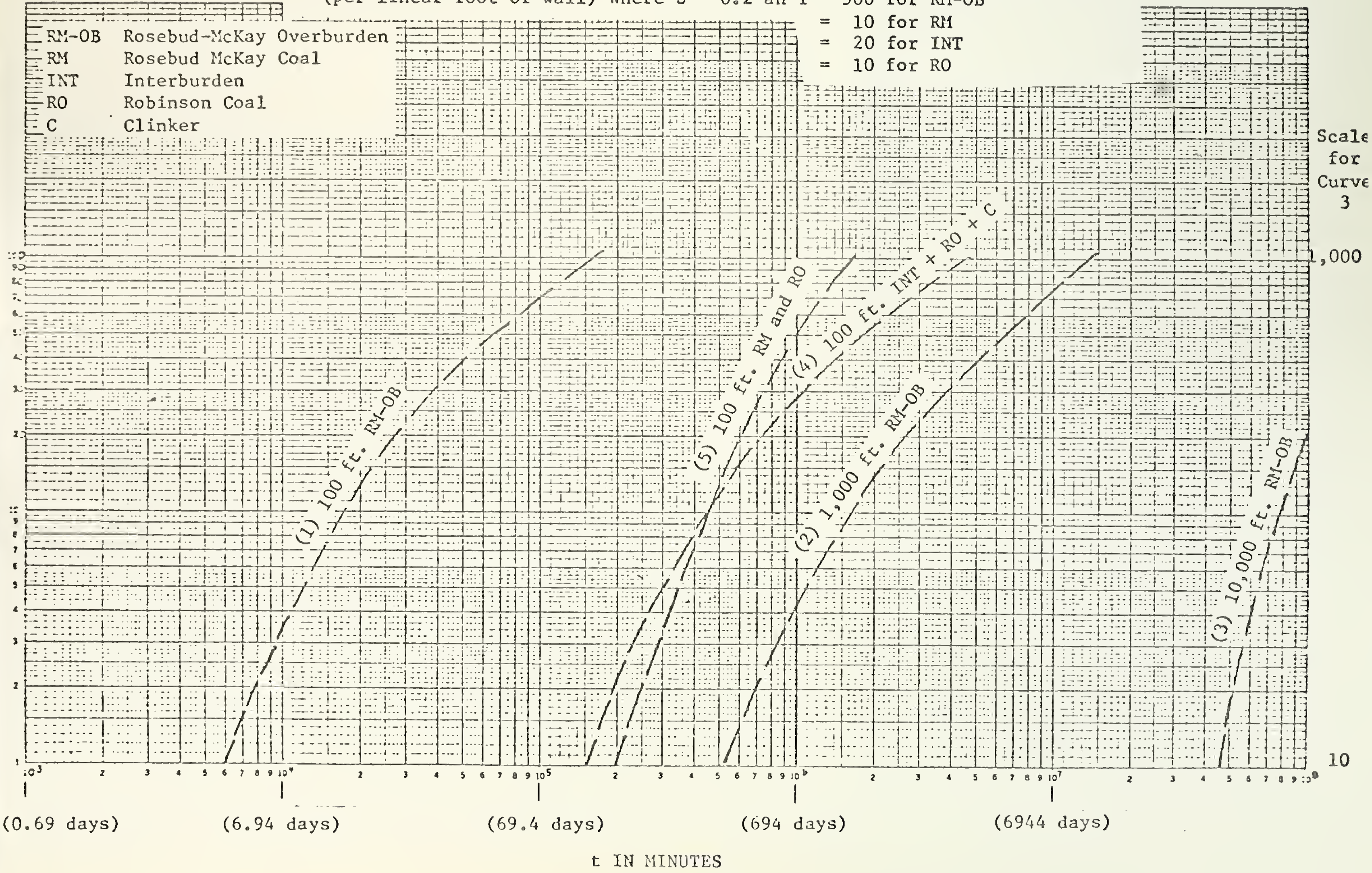
[a] RM-OB: Rosebud-McKay Overburden; RM, Rosebud-McKay Coal; INT, Interburden; RO, Robinson Coal; C, Clinker of Rosebud-McKay Coal.

[b] Assumes Clinker contribution similar to Rosebud-McKay Coal inflow.

[c] Assumes contribution from all zones for entire cut length.

[d] Assumes replacement material is as permeable as original material.

FIGURE 1 THEORETICAL TIME-DRAWDOWN GRAPH FOR A DRAIN DISCHARGING AT Q_b
(per linear foot of wall) Where S = 0.2 an T = 500 for RM-OB
= 10 for RM
= 20 for INT
= 10 for RO



APPENDIX H - REVEGETATION PLAN
(WESTMORELAND RESOURCES, 1976a)

PLANTING AND REVEGETATION

1) A suitable permanent diverse vegetative cover capable of meeting the criteria established in Section 12 of Title 50, Chapter 10, will be established on areas of land affected except traveled portions of railroads, roads and areas of authorized water confinement. Seeding will take place during the first appropriate season following completion of grading, topsoil redistribution and remedial soil treatment.

2) Areas that can be worked with machinery will be drill seeded as suggested by the Soil Conservation Service, at 1/2 to 3/4 of an inch depth. Areas that cannot be traversed with equipment will be broadcast seeded.

The Department of State Lands has suggested the following seed mixture for broadcast application:

Native	Rate lbs./Acre PLS
Western Wheatgrass	4
Bluebunch wheatgrass or Whitmar beardless wheatgrass	3
Side oats grama	2
Little bluestem	1
Green needlegrass	2
Prairie sandreedgrass	1
Blue grama grass	1
Thickspike wheatgrass	2
White prairie clover	2
Skunkbush sumac (selectively seeded or planted	Trace
Ponderosa pine (Selectively planted)	Trace
4-wing saltbush	Trace
Introduced	
Hard Fescue	1
Kentucky bluegrass	2
Yellow sweet clover	1
Pubescent wheatgrass	1
Eski sainfoin	1

Broadcast seeding will be done at a rate of 23 lbs. PLS per acre. Drill Seeding will be done at a rate of 17 lbs. PLS per acre. Ten lbs./acre barley or wheat will be sown with the perennial mixture for temporary stabilization.

In accordance with Supplement A to Permit No. 74005, Westmoreland Resources has implemented a plan to develop ponderosa pine seedlings. Seed was gathered at the Absaloka mine site, and 3000 seedlings are being developed by the Montana State Forest Nursery in Missoula for delivery in 1977. Seedlings of golden current and skunkbush sumac also are being developed by the State Forest Nursery for delivery in 1977.

Westmoreland Resources has implemented a program for the collection of seed of native tree and shrub species for use in revegetation and wildlife habitat development. Seeds of hawthorn and Wood's rose were collected in 1975 and sent to the State Forest Nursery for propagation. Future plans include the collection of seeds of choke cherry, wild plum and skunkbush sumac. Before delivery of seedlings begins, Westmoreland Resources will propose a program for the development of effective planting methods.

3) Westmoreland Resources obtains seed from Northrup King & Company in Billings, Montana. Every effort is made to obtain locally grown climatically adapted seed when available.

4) Seeding rates reflect the application rates of pure and viable seed.

5) Seeding will be accomplished during fall or early spring so that the best use can be made of early season moisture.

6) Terracing, seeding, harrowing, and other operations will be done on the contour, where possible, to assist in controlling erosion.

7) Soil amendments will be used as approved to supplement the soil and to aid in the establishment of a permanent vegetative cover.

8) Westmoreland Resources will use such other means as deemed necessary by the Department to insure the establishment of a diverse and permanent vegetative cover. The area of mining operations will be fenced off in order to separate construction and mining activities from cattle grazing on adjacent property. In future years, additional fencing will be done as required to protect revegetated land from immediate grazing pressure and to provide a test area to demonstrate that the area can withstand normal pasture use.

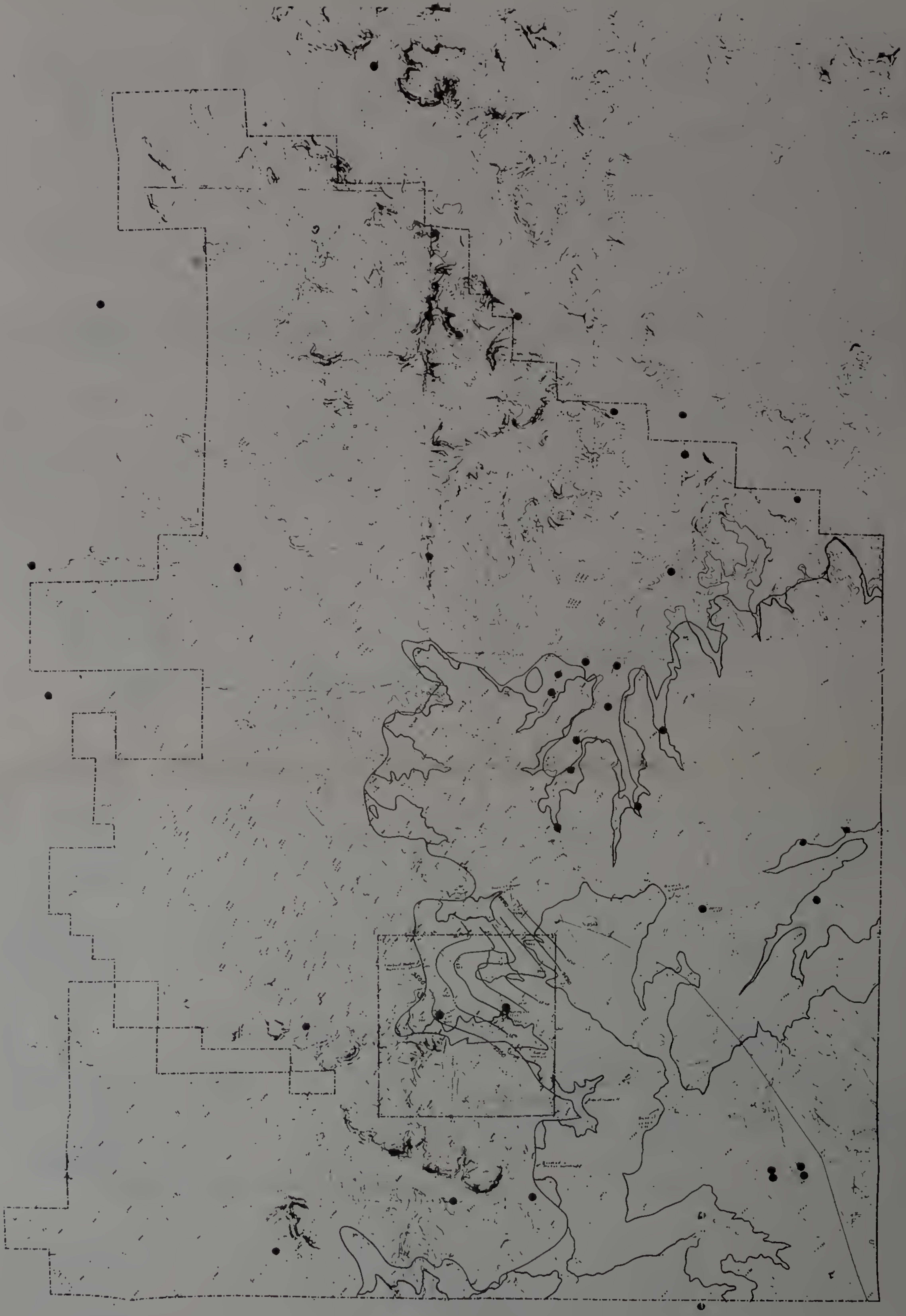
9) Annual grasses and/or legumes will be seeded if required on certain

areas by the Department; current seed mixtures utilize annual grasses and legumes for stabilization during the early stages of plant community development.

10) When required by the Department, mulch will be applied to prevent erosion or sedimentation.

11) In the event that the Department determines that a seeding has been unsuccessful, Westmoreland Resources will investigate the cause and prescribe a course of action so that vegetative cover can be established at the next seasonal opportunity.

12) It is anticipated that reclaimed areas will be utilized primarily for the grazing of domestic livestock. After vegetative establishment, Westmoreland Resources expects to institute a grazing system so that stand tolerance to grazing can gauged.



TOPOGRAPHIC MAP
OF THE
SARPY CREEK AREA
Big Horn and Treasure Counties, Montana
tract 3
prepared by
KNOX BERGMAN-SHEARER CORPORATION
Denver, Colorado 80218

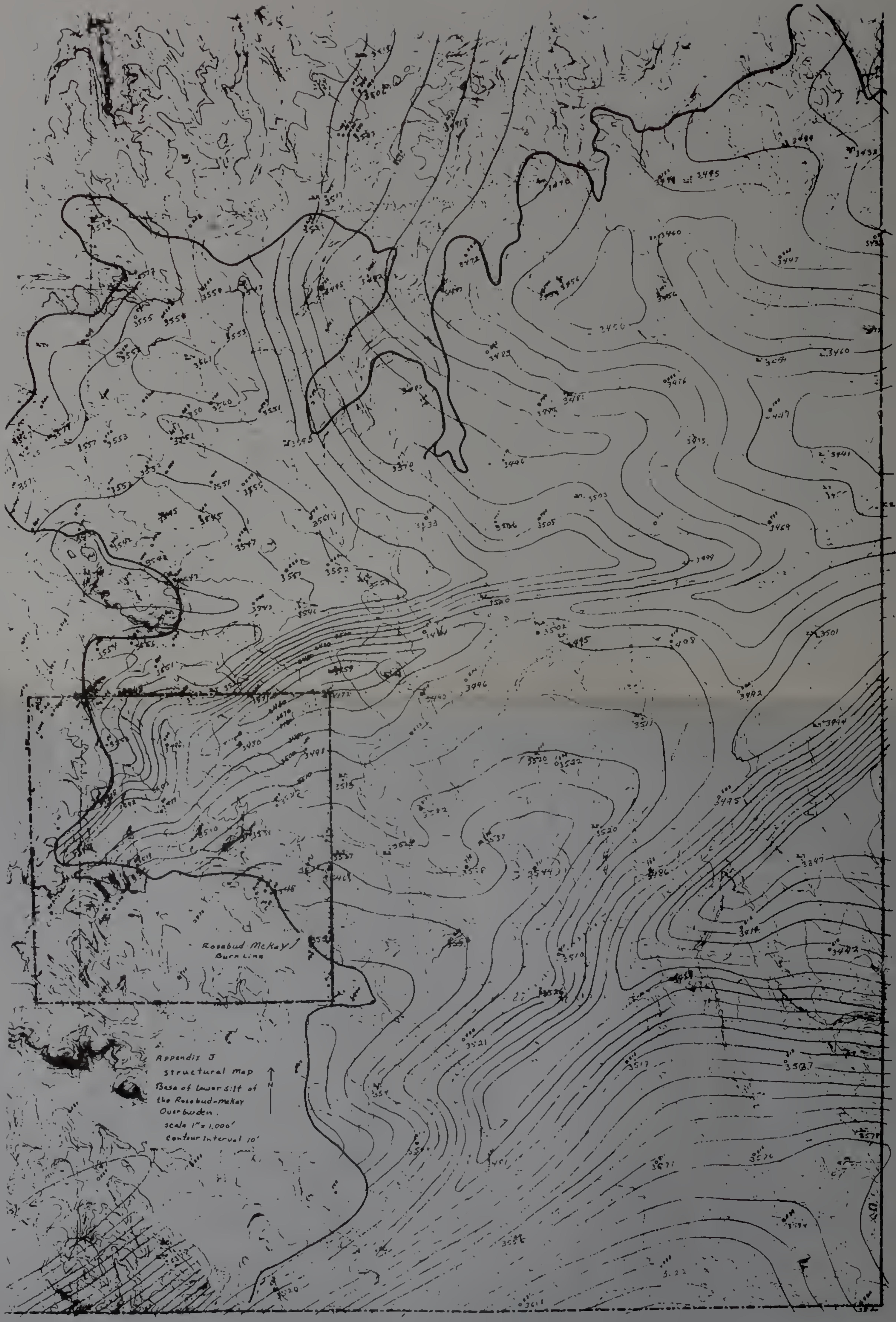
feet
1000 500 0 1000 2000 3000 4000 5000

Scale 1" = 1000'
Contour Interval 10'

WESTMORELAND RESOURCES
TRACT III
BIG HORN COUNTY, MONTANA

DISTRIBUTION OF ROSEBUD-MCKAY OVERBURDEN

Base of Upper Silt
Base of Lower Silt
● Spring Location
Line of Cross Section
Potentiometric Contour Map
[illegible] Of Overburden



Appendix J
structural map
Base of Lower silt of the Rosebud-McKay Overburden.
scale 1" = 1,000'
Contour Interval 10'

1000 feet 2000 3000 4000 5000

Scale: 1" = 1000'
Contour Interval 10'

TOPOGRAPHIC MAP
OF THE
SARPY CREEK AREA
and Treasure Counties, Montana
tract 3
prepared by
KNOX BERGMAN SHEARER CORPORATION
Denver, Colorado 80218

WESTMORELAND RESOURCES
ABSALOKEE MINE AREA
M.S. TUDOR - NOV., 1977

APPENDIX K - CORRESPONDENCE AND PUBLIC COMMENTS AND RESPONSES ON THE DRAFT IMPACT STATEMENT

All articles, papers, etc. sent to DSL
are on file in DSL's office

WESTMORELAND RESOURCES
Post Office Box 449, Hardin, Montana 59034 (406) 342-5241

July 20, 1977

Mr. Brace Hayden
Montana Department of State Lands
Capital Station
Helena, MT 59601

Dear Brace:

Thank you for the opportunity to submit our comments on the Draft Environmental Impact Statement covering Westmoreland Resources Proposed Expansion of Absaloka Mine into Section 36. We would like to compliment you and the Department for the preparation of a thorough, realistic, and complete EIS. Specific comments on the EIS are attached.

We have several general observations relating to the Draft EIS, which are covered where appropriate in our specific comments. However, I would like to summarize them here also so that you will be aware of our concerns.

In the sections on vegetation and wildlife in particular, one gets the impression from reading the EIS that Section 36 is a green oasis in the middle of a desert. The productivity of Section 36 for grazing purposes is a function of the soils and plant communities which are present there rather than the availability of a water source. Grassland communities influenced by above average moisture availability are highly localized in the vicinity of seepage areas, and are insignificant relative to the overall carrying capacity of the Section. Trees and shrubs along drainageways may be utilizing sub-surface water,but at a depth too great to be utilized by grazable herbacous species. Shrub thickets including such species as hawthorn, plum,chokecherry, ash, and box elder are typical of drainage bottoms in the area. These plant communities develop where conditions are mesic, but the source of water is not necessarily ground water. Similar communities often develop where moisture conditions are favorable due to overflow conditions, above average snow accumulation during the winter, shading on north slopes, or combinations of these factors.

We have examined soil maps and calculated carrying capacities for several other state sections in the area for comparison with figures given in Appendix D. In calculating carrying capacities, we used condition ratings for the various range sites as measured on Section 36 during 1975, which we feel are representative of the general area. The results are as follows:

Location	AUM's Per Acre (DSL)	AUM's Per Acre (WR)
T1N-R37E S36*	.38	.28
T1N-R37E S16	.32	.29
T1N-R36E S36	.27	.30
T1N-R38E S16	.30	.29
T2N-R36E S16	.30	.30
T2N-R36E S36	.22	.28

Please note that based on consistent range conditions, the range in AUM's per acre among these six state grazing leases is from .28 to .30; the grazing capacity of Section 36 T1N-R37E is estimated by this method to be .28 AUM's per acre. Mike Bishop asserts in his memo that over-grazing of Section 36 was a result of anticipation that the Section would be mined. It is our observation that this is not correct. The condition of Section 36 is such that it would of had to of been over-grazed for quite some time. The condition of Section 36 is not unlike the remainder of Tract III.

Regarding the value of Section 36 as wildlife habitat, it is typical of the entire upper Sarpy Creek drainage. The complexity of vegetation arises primarily as a result of dissected topography, which in turn is largely related to the burning of coal seams in the area. In wildlife studies conducted by ECS, and more recently in studies conducted by Westmoreland Resources (report preparation not yet complete), Section 36 does not stand out as an outstanding wildlife area within the Tract III lease. We agree that wildlife habitat values are present, but are not exceptional relative to the surrounding area.

We are concerned that existing environment and impact sections relating to ground water hydrology are based largely on a rather speculative assumption that transmissivities and permeabilities in Section 36 will be greater due to greater fracturing in the structural low. This may very well be the case, but it is not demonstrated by existing hydrologic data. We feel that the analysis should be based most heavily on the data which is available with possible increased fracturing etc. placed in its proper prospective.

In sections relating to air quality, violations of ambient air quality standards are referred to several times. These "violations" occurred at sampling stations in close proximity to coal processing equipment and unpaved roads in the mine area, and are not representative of ambient air conditions at the property line. Westmoreland Resources has discussed plans for expanded air quality monitoring with the Air Quality Bureau; additional samplers are to be installed in the near future.

The Air Quality Bureau feels that surface mining is the primary reason for elevated levels of total suspended particulates in the town of Colstrip. This conclusion is drawn largely from a study conducted for the Environmental Protection Agency by PEDCo Environmental, Inc., dated March, 1977, and entitled "Eastern Montana Coal Resource AQMA Analysis". We have examined this report closely, and we feel that conclusions of the investigators are not supported by the data, primarily because during the year of study (1974), all mining activity was downwind of the sampler in Colstrip. In addition, two samplers located downwind of the operations showed suspended particulate levels in compliance with the ambient air qualtiy standards. There are many questions yet to be answered regarding total suspended levels related to surface coal mining operations. However, we feel that additional site specific monitoring is required before any conclusions can be drawn.

We are concerned that the economic implications of mining or not mining Section 36 have not been considered in this EIS. Royalties, severence taxes, gross proceeds taxes, and resource indemnity taxes are expected to total nearly $60 million as a result of the proposed mining of Section 36. The value of this income to the State and its possible use for mitigation of socio-economic impacts must not be overlooked.

Thank you for the opportunity to review this Draft Environmental Impact Statement. Aside from these observations, we feel that it is an excellent piece of work. If you would care to discuss any of our comments, please do not hesitate to give me a call.

My best regards,

Dave

David W. Simpson
Environmental Administrator

bjz

WESTMORELAND RESOURCES
Post Office Box 449, Hardin, Montana 59034 (406) 342-5241

DWS

August 11, 1977

Mr. Brace Hayden
Department of State Lands
Capitol Station
Helena, MT 59601

Dear Brace:

Thank you for sending comments received on the Department's "Section 36" EIS. We have reviewed these comments carefully, and we would like to respond to a number of points and issues which have been raised. Following are responses to each of the comment letters:

1. State of Montana Department of Fish & Game:

The development of wildlife habitat in reclaimed areas is a goal of Westmoreland Resources' reclamation efforts. If the Department of State Lands desires that wildlife habitat be a singular objective in the reclamation of Section 36, Westmoreland Resources would be pleased to cooperate in the development and implementation of such a plan.

2. The United States Department of the Interior, Bureau of Indian Affairs:

Several of the points raised by the BIA were addressed in Westmoreland Resources' comments of the Draft EIS. We have no further response.

3. United States Environmental Protection Agency:

The EPA comments relate most directly to the U.S.G.S. Final Environmental Impact Statement on the Proposed 20-Year Mining Plan. We feel that a "management scheme to provide water to the area after it is mined" in the detail described by EPA is perhaps premature at this time. The availability of an alternative water supply in the sub-Robinson unit which is of adequate quality and quantity for livestock watering has been demonstrated by the baseline studies. The replacement of water supplies is far into the future, and we feel that the specifics of water replacement strategies can be better defined based on hydrologic monitoring studies now in progress and to be implemented in the future. For example, it may be possible to pump water from replaced spoils, but the potential of this unit to supply water for livestock will not be known for some time. Siting of wells, methods of pumping, design of storage tanks, etc., will require approval by the Montana Department of State Lands. The availability of an alternate water supply is known. We feel that the means by which this water supply is to be utilized can be better decided upon at the time of implementation.

Regarding EPA comments relating to quantitative estimates of post-mining ground water conditions and water quality, we feel that any assessments beyond those which already have been performed would necessarily exceed the present state of the art. The ground water resource of Tract III has been defined in detail by baseline studies; the impact assessments which have been developed are those which logically follow from the baseline data. The EPA apparently does not recognize that the amounts of ground water involved are very small. The coal units have only a very limited ability to transmit ground water as demonstrated by pumping tests. Westmoreland Resources has installed additional monitoring wells in the East Fork Valley and in tributaries thereto in an effort to better define the contribution of ground water from Tract III to the East Fork valley. It is agreed that it would be beneficial to have more quantitative post-mining ground water quality information. However, there are no accepted methods at present for predicting post-mining ground water quality. The question of water quality in spoils is addressed on pages 259-260 of FES 77-17. This is an area in which research is only now getting under way.

The "inter-related system of springs and subirrigated area in the proposed mine area of Tract III" is somewhat of an over statement. Most of the springs in the area could be better defined as seeps, which result in limited areas of water influenced vegetation the extent of which may be measured in fractions of an acre. Furthermore, subirrigation in the valley of the East Fork of Sarpy Creek is yet to be documented. Test wells in the East Fork valley have shown water levels to be sufficiently below the surface to preclude utilization by all but the most deep rooted of species. There are no alluvial valleys in the proposed mine plan area. The limited ability of aquifers in the mine plan area to transmit water and water losses between discharge points and the valley floor suggest that any effects on the East Fork of Sarpy Creek will be minimal.

The mining of Alternative Area 2 is not a viable alternative to mining in the proposed mine area. First, Alternative area 2 does not have the necessary reserves to meet minimum production requirements specified in the amended Tract III lease. Second, Alternative area 2 is underlain for the most part by single seam Robinson coal, requiring that nearly three times the acreage be mined in order to recover a given tonnage. Third, there is not yet an engineered mining plan for Alternative area 2. It would be necessary to develop such a plan and submit it to the U.S. Geological Survey, which would require preparation of another environmental impact statement before the plan could be approved. This could not be accomplished within the time frames necessary to assure continuous production to meet contract commitments.

In summary, we feel that the reservations outlined by the EPA are overstated when considered in the context of the magnitude of the ground water resource at the limited potential for offsite effects.

4. United States Department of the Interior, Bureau of Outdoor Recreation:

Because most new jobs created by the mine expansion will be filled from the local labor force, significant increases in population are not expected. Population increases as well as possible effects on recreational resources have been discussed in the Final Environmental Impact Statement prepared by the Bureau of Indian Affairs on the Tract II and Tract III coal leases.

5. Friends of the Earth, Inc., Letter of July 27, 1977:

Overgrazing of Section 36 has been documented by vegetation sampling in 1976. It should be pointed out that in selecting locations for sampling, an effort was made to locate areas in high condition so that potential plant communities could be better defined. Samples were not taken in the most severely overgrazed areas, so the overall carrying capacity of Section 36 probably was overestimated by the survey. There is some descrepency in the figures given in Mr. Dobson's point #2. On Section 36, approximately three acres are required to support one AUM, an area equal to about 18 miles of four-wheel drive travel. This is considerably higher than a 1 2/3 mile given in a Billings Gazette article. Although there has been considerable vehicle activity on Section 36, it is doubtful that even one AUM has been affected.

Mr. Dobson apparently does not understand the concept of range condition. Range condition is a function of plant community composition relative to the potential climax composition, and has nothing to do with the degree of utilization by cattle (or grasshoppers) in any given year. Overgrazing for a long period is required to shift plant community composition to the degree observed in Section 36. An exerpt from a draft copy of the Big Horn County Soils Report is enclosed for background. Although some portions of the Section, notably areas removed from water in difficult terrain, are in good to excellent condition, most of the Section is in fair condition, with poor condition noted on lower slopes and drainageways where cattle tend to congregate. As Westmoreland Resources stated in its comments on the Draft EIS, we do not know how a figure of .38 AUM/acre was calculated. Based on present range condition, the carrying capacity of this Section is approximately 0.29 AUM/acre, or about average for this area.

6. Friends of the Earth, Inc., Letter of July 22, 1977:

Page 9: The mining plan presented in the U.S.G.S. FES 77-17 was that submitted to the U.S.G.S. on September 30, 1975. Since that time, the mining plan for Section 36 has been revised several times. Relative to the U.S.G.S. Environmental Statement, this of no consequence since the U.S.G.S. does not regulate mining in Section 36. Section 36 was included in that mining plan to facilitate understanding of the mining plan as a unit.

Page 10: The mining plan for Section 36 was prepared prior to the 1977 amendments to Title 50, Chapter 10, R.C.M. 1947, and as such shows one year of mining. Detailed mining plans for subsequent years are described in Westmoreland Resources' "Supplement to Proposed 20-Year Plan of Mining and Reclamation" to comply with 30 CFR 211, submitted to U.S.G.S. on May 17, 1977, and shortly thereafter, to the Department of State Lands.

Page 31: As pointed out by Westmoreland Resources in comments on the Draft EIS, suspended particulate levels exceeding ambient air quality standards in the immediate mine area in close proximity to unpaved roads and coal handling facilities are not indicative of violations beyond the property line. Westmoreland Resources currently is expanding its monitoring system so that ambient air quality can be better documented.

Page 35: The potential for replacement of stockponds is discussed in the DES on page 116. The drainage areas given on page 35 of the Draft EIS require revision. Please refer to the U.S.G.S. Final Environmental Statement 77-17, pages 75-76.

Page 39: Figure 6, like most of the maps presented in the environmental baseline studies, the tract boundaries have been modified to include private coal rights held by Westmoreland Resources. Westmoreland does not hold coal rights for the small amount of land east of Tract III purchased from Merle Cox. Regarding the alleged missing springs, many of the seepage areas characteristic of the coulee bottoms are so diffuse as to render the definition of a spring quite difficult. In many cases, a "spring" can be created by excavating the coulee bottom. In addition, many springs are seasonal, drying up in late summer and fall. the spring inventory for Tract III was prepared by Wayne Van Voast during 1972 and 1973, and is considered to include all known or readily discoverable springs.

Page 38: The existing environment section is not a proper place in the DES for evaluating the effects of mining. Possible effects on ground water flows are discussed in the impact section. The U.S.G.S. response related directly to Mr. Dobson's comment, in which he described "subirrigated dryland croplands" east of Tract III. Localized subirrigated conditions in coulee bottoms associated with seepage areas do not constitute subirrigated cropland.

Page 42: Again, the well inventory was prepared by Wayne Van Voast during 1973, and included all known or readily discoverable wells.

Page 41: Dames & Moore did not prepare a potentiometric map of the Rosebud-McKay overburden because of its limited extent in the lease area. Inconsistency of the sandstone units of the overburden is such that mapping over large areas is not possible. Although there may be lateral recharge to the overburden from the south, it is probable that most recharge to this unit is local in origin. The available data points for water levels in the overburden indicate that the configuration of potentiometric surface is similar to that of the underlying units. Impermeability of the interburden is such that it cannot be considered an aquifer.

Page 47: The location of the present ground water divide is heavily influenced by discharge points along Sarpy Creek and the East Fork of Sarpy Creek, which decrease potentiometric heads toward the west and northeast, respectively. If relative discharges to these drainages do not change as a result of mining, it is probable that the location of the ground water divides will not change appreciably.

Page 50: Section 36 is typical of the surrounding area, with a grazing capacity of .29 AUM's/acre based on vegetation measurements. Section 36 is typical of the upper Sarpy drainage, and does not stand out as a singular area of highly diversified vegetation. If Section 36 was ever farmed, its abandonment would indicate a lack of suitability for agriculture. Hence, Section 36 would not qualify for "Prime and Unique Farmlands" criteria.

The Department of Fish & Games' bird study relates to the sharptail grouse dancing ground north of the present mine area, and does not relate directly to Section 36. Sharp-tailed grouse are only rarely observed in Section 36.

Page 51: Associated disturbance areas to the west of proposed mine areas will not be disturbed by topsoil salvage or mining activities, and wildlife habitat diversity will be retained.

Page 80: The comment refers to a single platform burial with no remaining traces other than a few trade beads. Section 3 is sufficiently removed from Section 36 that this comment hardly seems pertinent.

Page 81: Presumably, Mr. Dobson is referring to the county road which used to cross Section 36 before it was established in its present location. This would hardly qualify as an important cultural resource. The East Fork Sarpy Basin is not an issue in this impact statement; Section 36 is in the drainage of Sarpy Creek.

Page 85: Westmoreland Resources has previously addressed the question of air quality.

Page 88: Sub-Robinson wells will provide water of suitable quality for livestock watering. Please refer to water quality data submitted by Westmoreland Resources in the Dames & Moore Hydrology reports, and which appear in the U.S.G.S. FES 77-17.

Page 89: Impoundments will create aquatic habitats and water sources where they do not now exist. Such a habitat change is not equivalent to the destruction of habitat diversity. The shrub thicket coulee bottom habitat in the southwest quarter of Section 36 has been so affected by overgrazing that its value as wildlife habitat is negligible.

Page 93: Due to the patterns of ground water flow and the fact that overburden seepage probably arises primarily from local recharge within the particular watershed, it is quite unlikely that mining of Section 36 would have any effect on the East Fork drainage. The springs in the East Fork drainage are neither critical nor unique; rather, such ground water discharge is typical of dissected sedimentary strata of the Fort Union Formation.

Page 93 & 94: Alleged inapplicability of the Westmoreland data to Section 36 is an inference which is not supported by existing information. Please refer to pump test data at test well location 6 in Section 36. As pointed out by Westmoreland in its comments on the Draft EIS, impact assessments should rely on available data, with possible exceptions placed in proper perspective.

Page 97: Regarding the probable locations of future spring flow, we believe the Department intended to refer to the Robinson rather than the Rosebud-McKay coal. The potential for saline seep does not appear to be great based on average overburden plus interburden conductivity values reported by the Colorado School of Mines Research Institutue, which ranged from 0.9 to 6.6, with an average of 2.98 for 29 drill holes.

Page 99: It is unlikely that any plant species would be completely eliminated. The proportions of various species in post mining plant communities will depend on the ability of the various species to compete in the reclaimed environment. Although the list of species occurring in the Sarpy Creek area is extensive, a relatively small number of species may be classed as dominant in the present plant communities. These are discussed in Appendix E.

Page 100: Overgrazing of Section 36 is a fact which has been documented by vegetation sampling. Please refer to the Vegetation Report for Section 36 submitted by Westmoreland Resources on October 4, 1976.

Page 102: The information which is needed can only be gained through experience gained from wildlife studies in reclaimed areas. From a practical standpoint, reclamation will be "successful" when soils have been stabilized by revegetation such that invasion by native species can occur and a successional pattern can become established. Legal considerations will require that an ability to withstand grazing at a level comparable to that before mining can be demonstrated. The time required to attain this level of plant community stability is not yet known.

Page 103: The word "temporary" apparently refers to "temporary decline in small mammals" while mining is in progress. Small mammal trapping studies to date have shown that small mammals readily invade reclaimed areas, and are present in numbers at least as great as in unmined areas as early as the first growing season after seeding. Avian mortality from impact with the dragline is a potential impact of infrequent occurrence. There is no indication that activity in the mine area is having any detrimental effect on mule deer. Mule deer have become accustomed to mine activities and are often observed within the mine area. Reproduction of mule deer on Tract III during 1976 was excellent, as indicated by studies conducted by the Montana Department of Fish and Game and Westmoreland Resources.

Page 104: The "60 unit trailer park" is a figment of Mr. Dobson's imagination. Mr. Romine has initiated construction on a trailer park which will include 10 units at a maximum. This does not seem relevant to the mining plan for Section 36.

Page 111: As nearly as an archeologist retained by Westmoreland can determine, the term "medicine rocks" is a local colloquialism for caprock sandstone formations. This conclusion is based on discussions with Mr. Joseph Medicine Crow, an archaeologist and Crow Tribal member. There is no indication that these rocks have any archaeologic significance.

Page 113: The proposed mine plan does not conflict with any of the provisions of the Surface Mining Control and Reclamation Act of 1977.

Page 114: Measurements of total suspended particulate levels within the mine area exceeding ambient air quality standards do not constitute air quality violations at the property line. Expanded monitoring is necessary to determine effects of fugitive dust on ambient air quality. The quality of sub-Robinson water is satisfactory for livestock watering, which will be the post-mining land use. Well maintenance costs will depend on pumping methods. Perhaps windmills can be used at very small expense.

Page 116: The potential for damage to the sub-Robinson aquifer is extremely remote. Responses to Dr. Stephenson's comments are included herein.

Page 118: Section 36 has been generally overgrazed, particularly on lower slopes, and in the drainageways. Effects of overgrazing also are evident in the northeast portion of the Section. Although the entire Section is in reduced range condition, this effect is least evident on ridges and steep sloeps, which are used less by cattle than the more accessable areas. Although "wetland" range site on the section; about 30 acres would be required to increase the grazing capacity above its present level by one animal unit.

The diversity of wildlife habitat on Section 36 is primarily a function of topography. Varying slopes and aspects have given rise to varying plant communities, with deciduous shrub communities developing in the coulee bottoms where the moisture conditions are favorable. The "wet coulee" habitat is not unique in southeastern Montana. Mr. Matson in referring to "wet coulee" presumably means either the sedge communities which develop in areas of ground water seepage or deciduous shrub thicket communities characteristic of many coulee bottoms in the area. The combination of habitats present on Section 36, and for that matter in the entire upper Sarpy Creek drainage, does result in a diverse wildlife community. However, Section 36 cannot be singularly demonstrated to be critical wildlife habitat on the basis of studies conducted by Ecological Consulting Service, and more recently, by Westmoreland Resources.

In his discussion of reclamation success, Mr. Matson has referred to early studies at Colstrip which do not include replacement of topsoil as now required by state law. Therefore, this entire discussion is irrelevant.

8. Letter from Gary Matson to Secretary of the Interior dated July 15, 1977:

Vegetation of the "spring fed coulees" is hardly unique. Several distinct vegetation types can be identified and related to moisture conditions. Marshland communities, commonly dominated by cattail and bulrush, have developed where moisture is relatively constant. These communities are highly localized, and their extent can be measured in square feet. Coulee bottoms below these seepage areas in most cases support the community dominated by sedges. In Soil Conservation Service terminology, these are wetland communities; wetland communities develop where inundation occurs for a portion of the growing season. Very small areas of subirrigated grassland probably are present, but in most cases these and overflow sites in the coulee bottoms further down stream have been considerably modified by overgrazing. The dominant plant community at this time is a snowberry-bluegrass type. Bluegrass is an invader which is not an important part of the native grassland community. A dominant vegetation of these coulee bottoms is snowberry, with wetland and marshland communities of such a small extent that they could not be delineated on vegetation maps.

The extent of the coulee bottom communities is so limited that the effect on overall range capacity is negligible. Wetland communities have a carrying capacity twice that of the surrounding range land. Carrying capacities in the area are generally about .30 AUM/acre; about 30 acres are required for animal unit assuming a 10 month grazing season. Therefore, the presence of 30 acres of wetland range would increase the carrying capacity above its it has not been measured, range condition in the vicinity of the stockpond appears to be very low, with cheatgrass and broom snakeweek dominating. As previously pointed out, the grazing capacity of Section 36 is approximately .29 AUM/acre. Changes in soil types, lessening of slopes, improved species composition, and redistribution of water sources in the Section could very easily increase the overall carrying capacity of Section 36.

Page 119: Continuous experimentation in reclamation is necessary to improve reclamation methods, particularly where specific goals on reclamation are to be met. Soil conditions on Tract III in combination with climatic considerations indicate that the potential for successful reclamation is quite good.

Page 120: Although long term reclamation results are not yet known, short term results have consistently indicated the probability of success. With research now in progress, the state of the art is certain to advance dramatically in the next few years.

Page 128: Recovery of coal by vertical augering at this point is nothing more than an idea. Even if the idea is feasible, realization is years away.

Appendix G: Small amounts of alluvium are present in the coulee bottoms in the proposed mining area. The draw down of less than one foot at 1000 feet in the Rosebud-McKay overburden refers to a time period of one year, not three years. It should be pointed out that these draw down estimates assume a constant discharge, which will not be the case since flows will be reduced as dewatering occurs and gradients are reduced. This is pointed out in the next to the last paragraph. Due to the nature of the ground water system and the fact that most recharge to the overburden is probably local it is highly unlikely that mining in Section 36 would have any effect on the East Fork drainage.

Draw down in coal aquifers to a distance of 100 feet cannot exceed one foot because the pit cycle time would be less than 140 days. Since the pits will be 200 feet wide, the draw down at 100 feet cannot exceed one foot. In its application, Westmoreland Resources included a buffer zone adjacent to the Crum properties, since these had not been acquired at that time.

7. Letter from Gary Matson dated July 23, 1977:

The productivity of Section 36 cited by the Department of State Lands is based on a high range condition which is non-existent. As a result of overgrazing, plant communities have been modified to the point that the grazing capacity is about 0.29 AUM/acre. Higher levels of grazing can only result in further range deterioration. Moisture conditions in Section 36 resulting from ground water seepage can have only a negligible effect on the overall carrying capacity, since the related plant communities are extremely localized in extent. There is less than one acre of present level by one animal unit per year. Since the total acreage of this type on Tract III is certainly much less than 30 acres the effect on carrying capacity is negligable.

The wildlife habitat value of the wet coulees is related to the presence of deciduous shrub species, which provide cover and food for a number of wildlife species. The limited areas of water influenced herbacious communities have a minimal influence on the wildlife community. Surface water, where present, almost certainly influences the distribution of terrestial species, and supports limited populations of aquatic species. A "pond centered community" will develop rapidly where surface water is present. For example, the sediment pond at the existing mine site supports large numbers of leopard frogs as well as painted turtles and muskrats. A number of species of waterfowl have been observed also. This pond has been in place for less than five years, yet willows, cottonwoods, cattails, and a number of other water influenced plant species are beginning to develop. Wells emplaced after mining to provide water for livestock, and sediment control facilities if left in place will provide sources of water and aquatic habitat once mining is complete. If impoundments are permitted to remain in place, it is likely that an aquatic habitats will increase over what are presently available.

Discussions of reclamation success and failure relate to experiments performed at Colstrip using raw spoil material. The fact that state law now requires salvage and return of topsoil is ignored. There is little doubt that shrubs and trees can be established on reclaimed areas based on experience with shelterbelt and windbreak development in the Northern Great Plains.

We seriously question whether any true subirrigation exists east of Tract III or in the valley of the East Fork of Sarpy Creek. If subirrigation truly is present east of Tract III, potentiometric maps clearly show that recharge must necessarily come from the south. We do not agree that Tract II and Alternative area 2 of Tract III are less sensitive than the proposed mine area. Tract II has more identified springs than Tract III. In addition, Alternative area 2 and practically all of Tract II are dominated by broken topography, which in turn has resulted in a diversity of plant communities, to an extent greater than that found in Section 36, or for that matter in the 20-year mining plan as a whole. In addition, the soils present in the proposed mine area are such that the prospects for reclamation given the current state of the art are excellent. Topsoil availability in Alternative area 2 and most of the Tract II is more limited. Although this in itself does not preclude the possibility of reclamation, we feel certain that progress in reclamation research during the next few years will better enable us to utilize resources which are present.

9. Letter from David A. Stephenson, Professor of Geology, to Mr. Edward Dobson, dated June 8, 1977:

1) No response is required; we agree with the last sentence of the comment.

2) Close examination of Figure 2 on page 8 of the DES will show that the 70' to 130' thickness refers to the overburden thickness, not the interval between the Stray 1 and Rosebud-McKay coals.

3) The proposed design for the water control facilities meets Federal requirements, which is to retain the 10-year frequency storm of 24-hour duration. Concerning the professor's question regarding the impact of dam failure as a result of a storm of greater intensity, apparently he did not give a great deal of thought to the conditions that would exist during such an event. As mentioned on page 248 of the DES such an event is unlikely and should it occur, the receiving streams downstream from the breached retention structure would probably be at similar extreme flood stages. Hence, overflow or breached contributions from the small drainage basin controlled by the structure would be amply diluted by the tremendous volumes of water in the main receiving stream. As such, there would be essentially negligible water quality pollution, either by increased sediment load or chemical quality of the water.

4) In the project area, direction of flow of each aquifer system is influenced by points of discharge, resulting in a ground water divide within each system. Each system consists of continuous hydrologic connection between recharge and discharge areas. The occurrence of ground water discharge areas depends on the outcropping of aquifers, which is mainly controlled by topography in this area since the strata are nearly flat lying.

5) What is meant by a discontinuous zone of saturation is defined on page 112. The zones of discontinuous saturation occur near points of discharge. This does not imply that vertical separation exists within a single aquifer.

Professor Stephenson asks the questions as to whether a perched aquifer system exists. The answer is "probably not". The Rosebud-McKay overburden aquifer zone on Tract III is essentially an unconfined aquifer. However, it is possible that less pervious layers in this zone may trap water forming local "perched" water levels, but these are probably of minor significance. The zone derives its recharge locally from infiltration of precipitation over the area and through lateral migration of ground water derived from outside this area. The Rosebud-McKay, Robinson and sub-Robinson are confined aquifers.

Concerning his last question under 5, there is local relief (hydraulic gradient) on the water tables of aquifers within Tract III as shown on Figures 23, 24, and 25. Near points of discharge these water table surfaces (gradients) have more abrupt relief than elsewhere within the system.

6) Professor Stephenson's conclusion that "there is an obvious good hydraulic connection from the water table to depths of several hundred feet" is erroneous if he means between the various aquifers. He references Figure 26 and 27 of the

DES which show a small water table rise for the aquifers during the spring and early summer months. One should not interpret the one to three-foot fluctuations in the annual water table levels for these aquifers to mean there is an obvious good hydraulic connection between the units. The approximately one foot change within the sub-Robinson unit could be a result of barometric pressure at time of recording and not an annual water level fluctuation. The gradual rise and decline of the water tables within the overlying Robinson and Rosebud-McKay aquifers does suggest an annual water table fluctuation. However, this does not mean there is a good hydraulic connection between the aquifer units. In fact, results from the extensive drill-hole data within the area shows that major aquicludes separate these aquifers from one another.

Concerning professor Stephenson's second paragraph under item 6, we do not consider the coal field hydrogeology to be overall "highly variable" in nature as stated by his comments. Field investigations show there is a moderate degree of variability within each aquifer unit. However, the predominance of data shows that the coal aquifers have low permeabilities and transmissivities. This information in conjunction with the detailed geologic data known for the Tract III area, permits a rather high degree of assessment regarding the hydrologic impacts that will result from mining.

7) No Response is required.

8) We do not agree with the professor's statement that "It seems reasonable to assume that the permeability of replaced spoil could decrease, even if porosity does increase". It is true that increased porosity does not necessarily mean increased permeability (as shown in the porosity-permeability relationship between shales and sandstones). However, in regard to the increased porosity to be developed as a result of spoil material placement within a mine cut, the porosity would result mainly from large pore space occurring between rubble materials rather than in minute granular pore space between individual silt and clay particles. As a result, it is expected that the permeability of replaced spoils will be substantially increased over that of the existing overburden and interburden materials.

The statement that aquifers will be disturbed during the period of mining relates to the short term effects of truncating aquifers by mining. Probable effects after mining is complete and a new hydrologic equilibrium is established are addressed on page 253.

9) There will be a decrease in base flow discharge to springs and surface streams north of the proposed mine area for the overburden and Rosebud-McKay aquifers. However, the statement as mentioned on page 250 of the DES is factual in that overall reduction of flow in Sarpy Creek probably will not be significant as a result of mining.

10) We do not agree with professor Stephenson's statement that wells completed in the sub-Robinson could be substantially impacted as a result of mining, nor do we see where on pages 245 and 260 of the DES that comments suggest this could occur. The sub-Robinson aquifer does not receive any major contribution from overlying aquifers. The professor has continually assumed in his review comments that the sub-Robinson aquifer is hydraulically connected with overlying aquifers. This is an erroneous assumption and, as such, conclusions derived on this premise are not valid.

11) Although the DES does not contain a quantitative evaluation of the potential trace element constituents that may enter the existing ground water aquifers, the qualitative discussion presented on page 259 and 260 explains what is anticipated to occur as a result of mining, based on the data presently available. In addition, the DES contains a discussion of water quality analysis results obtained from spoil material from other active mines in southeastern Montana (page 261). To date, such results have shown that no water quality degredation has developed which would prohibit surface mining of coal. Review of the ground water quality analysis from wells down gradient to the mine on Tract III reveal that no adverse increase in concentration of trace elements has occurred to date.

12) The statement on page 370 which concludes that lowered water levels cannot extend beyond the valleys of Sarpy and East Fork Sarpy Creeks refers to the Robinson and higher level aquifers that occur on Tract III. Professor Stephenson has apparently interpreted this statement to include the water table within Sarpy and East Fork Sarpy Creeks. It is doubtful that any such effects would be significant.

10. Montana Department of Health and Environmental Sciences:

1) Our monitoring program was primarily designed to monitor background conditions and not the effects of ongoing mining operations. This approach was required by the 9th Circuit Court of Appeals in Cady vs Morton (June 19, 1975). Under this decision the Interior Department was required to do an EIS on the lease application ignoring "investments or commitments made by Westmoreland" under its present mining plan. The same environmental studies were used for the present application which was prepared concurrently. Westmoreland has met with state air quality experts and agreed to redesign its monitoring program to meet their objections. This effort has entailed a considerable expenditure of funds for consultants and additional monitoring equipment.

Violations of the short term (24 hours) primary TSP standard have been recorded only at monitoring station 3. As the Bureau correctly points out this station is directly adjacent to the coal crusher and therefore not representative of anything. The one violation of the secondary standard at station 2 may be explained by its direct proximity to a road. Since monitoring for enforcement purposes must be done at the site boundary for a non-point source, these stations do not indicate any probability of violations on a hypothetical monitoring station located over 2 miles away from the site of mining activities at the lease boundary. Based on the background levels and the distance from mining activities to the lease boundary, Westmoreland Resources strongly disputes the Agency's undocumented assertion that "violations of TSP ambient standards are occurring downwind from the mining operation".

The Air Quality Bureau's assertion that violations are occurring downwind can only be based on a recent study of mining activity in the Colstrip area (PEDCo Environmental, Southeastern Montana Coal Resources AQMA Analysis, March 1977). This study was done for the Bureau under an EPA contract. One monitoring site directly affected by a Montana power generating station, construction activity, and residential traffic showed violations of the primary TSP standard. The Burlington Northern monitoring site which most exactly approximates our present situation was two miles downwind from an active mining operation in 1976. The annual geometric mean at this site was 28.3 micrograms per cubic meter with a 24 hour maximum of 104 micrograms per cubic meter. Both of these numbers are well within the annual and 24 hour maximum ambient TSP air quality standards. Another monitoring site, the McRae wite, is about 6 miles downwind from the Peabody and Western Energy "Area E" active mining areas. Since 1974 this station has shown levels consistent with those of other "pristine" areas of eastern Montana. The Bureau's own data indicates that increases in TSP levels arising from mining operations are very local in nature. This conclusion is supported by an EPA study which suggests that fugitive dust from mining operations consists primarily of larger sized particles which settle to the ground within a short distance of their point of generation. Since EPA health effects criteria are more concerned with small particulates which combine with gaseous pollutants, a separate rural fugitive dust standard is being considered (41 F.R. 55558-55560, December 21, 1976).

In its analysis the Bureau seems to have ignored the health related basis of the air quality standards. The nearest residence downwind of the lease boundary is several miles distant. Air quality agencies generally model pollution sources to determine their effect on nearby residential areas.

Table 26 is cited by the Bureau for showing many violations of Montana's settleable particulate matter standard for residential and industrial areas. Dustfall samples are taken in uniform containers filled with water. The water is evaporated and the collected dust is measured. In the next step the area of the collection vessel and the amount of dust collected is factored to determine the dustfall if the collector were one acre in size. Westmoreland Resources hired a consultant and began its dust collection monitoring program in April, 1975. In order to have more readily available local air quality monitoring and analysis assistance, Westmoreland Resources asked Northern Testing Laboratories to evaluate its program and analyze its samples early in 1977. Northern Testing reported that the unusually high dustfall figures were due to the use of well water high in suspended and dissolved solids rather than distilled water. Distilled water was used to collect the May and June 77 samples, the data for which are attached. It is our position that the dustfall numbers showing violations of the Montana standard are probably invalid because of the use of a contaminated collection medium. During June of this year, Westmoreland Resources mined 411,000 tons which equals an annual rate of 5 million tons. The June dustfall data indicates our mining operations is within the state standard. Since the real point of monitoring for enforcement purposes would be at or beyond the lease boundary, the dustfall readings for enforcement purposes are probably much lower.

Westmoreland Resources will cooperate with the Air Quality Bureau and the Department of State Lands to establish a monitoring program that meets with the Bureau's approval. The 8 point program contained in the Bureau's letter is that discussed by the Air Quality Bureau and Westmoreland Resources. Westmoreland Resources welcomes the Bureau's assistance in its monitoring effort and will implement that 8 point program with concurrence of the Department of State Lands.

2) Westmoreland Resources disputes that violations of air quality standards are occurring or have occurred for the reasons indicated in our comments to the first point. The approval of this mining plan will not lead to a substantial increase in production until mid-1979 at the earliest and more likely the early 1980's because of mining equipment limitations. By this time all data related problems in the air quality area should be resolved and a sufficient data base for decision making will be available to the Bureau.

For the reasons listed in comment 1, Westmoreland Resources disputes that violations of air quality standards are occurring or will occur in the future. The recent dustfall data are within the Montana standard. Past readings showing a violation were probably due to collection errors. Westmoreland Resources is willing to cooperate with the state in a monitoring program, but feels there is no support for the Bureau's supposition that violations "are now occurring".

In order to boost production above the present level a new dragline will be delivered and assembled at the mine site. Due to the time required to transport and assemble the parts, no significant production increase can take place before mid-1979 at the earliest. This means that the particulate pollution will not significantly increase above present levels while the monitoring requested by the Bureau is ongoing.

3) The Bureau's assessment that air quality is "already poor" is pure supposition. Until the cooperative monitoring program is completed with air readings taken downwind no conclusions as to the state of air quality can be reached. The May and June dustfall data indicate that standards are being met. As stated in our comments no substantial increase in production will take place

until after this monitoring data is available because of production equipment limitations. Even when production levels increase in early 1980's, particulate concentrations will not increase at the same ratio.

As stated before, Westmoreland Resources will work with the state to establish a suitable monitoring program. Even when production increases, the particulate concentrations should show only a slight increase. A production increase means the land area and not the concentration of mining activity will be increased. Since all cuts will be nearly perpendicular to the prevailing wind direction, particulates may be dispersed over a wider area but not in much greater than present concentrations. By that time the data will be available from our monitoring program for the Bureau's comment that air quality is "already poor" is supported by no data and is therefore pure speculation.

4) This statement by the Bureau is highly misleading. Westmoreland Resources has received permits for its major pieces of coal handling and processing equipment from the Montana Bureau of Air Quality. All new equipment will meet federal new source performance standards. Existing equipment will be retrofitted to meet any new state regulations promulgated under the designation of the Billings AQCR as a "maintenance area".

Our coal handling equipment has covered conveyors, closed transfer points and enclosed storage. The design for this equipment was submitted to the Bureau of Air Quality and a construction permit was issued by the Bureau. When new regulations are promulgated pursuant to the designation of the Billings Air Quality Maintenance Area (41 F.R. 28002-3; July 8, 1976), Westmoreland Resources will comply with them. We feel that from a practical standpoint the control features incorporated into design of the existing facility are sufficiently effective that additional measures would not significantly decrease emissions.

The Bureau's assertion that "best available control technology is not in use" is based on misleading examples. On page 4 the Bureau states that "Coal dust laden air is moved to the outdoor atmosphere by fans without using control devices". This statement refers to one 36 inch fan which exhausts air from a coal sampling room. This evacuation is required to meet MESA occupational health and safety standards for personnel working in the sampling room. The reference to open chute dumping into trucks ignores the fact that very little dust is omitted from this activity.

5) We feel that the major sources of TSP pollution from a strip mining operation result from traffic on dirt roads. Westmoreland Resources maintains watering trucks to decrease dust emissions from traffic during dry periods. County Road 384 to the mine site will be paved by the county with energy impact funds this summer. This should significantly decrease dust emissions.

Topsoil removal and storage are carried out to insure proper reclamation after the coal is removed and the overburden is replaced. The direct replacement of topsoil is being carried out where feasible. The reuse of topsoil is required by Montana's surface mining law and good reclamation practice. All topsoil piles are seeded to restrict erosion. the storage and replacement of topsoil and the prompt seeding of the area restricts wind erosion and is an essential step in land reclamation. It is hard to see how this necessary pollution control activity can be creating an air pollution problem.

Blasting is a necessary step in our surface mining activities. It loosens the overburden and permits the dragline to remove it. Westmoreland Resources is presently conducting experiments to control dust from blasting, as the Air Quality Bureau is aware.

Westmoreland Resources has taken all reasonable steps to mitigate the air quality effects of its mining activities short of intermittently disrupting production or creating a safety problem for its miners. Given the many problems with the Bureau's PEDCo report, the consideration of additional control measures should await the development of accurate monitoring data.

6) The Prevention of Significant Deterioration Program (PSD) does not apply to coal mining or handling operations. Hence, there is really nothing to consider.

Under the PSD regulations promulgated by EPA, new sources that fall within one of the 19 classes of sources contained in the regulations must apply for a permit before construction. In the permit application the source must demonstrate that it will not exceed the pollution increase increment for its area of location. Coal mining and processing operations are not included within the 19 classes of sources requiring review (40 CFR 552.21). Since Westmoreland Resources is an existing operation, none of its present operations would be affected by PSD requirements anyway. If the PSD program is changed by Congress in the 1977 Amendments to the Clean Air Act and existing coal mining operations are required to receive a permit, Westmoreland Resources will comply.

The Bureau's assertion that the EIS is insufficient because it fails to discuss totally inapplicable issues is unfair.

Westmoreland Resources takes strong issue with many of Air Quality Bureau's comments. We have been willing and will continue to be willing to take every reasonable step to reduce particulate emissions from our operation. Unfortunately, the Bureau of Air Quality seems intent on expanding its regulatory jurisdiction by attacking the Westmoreland Resources mining permit. Only the Congress or the Montana State Legislature can give this Bureau the direct authority it seeks to review and issue mining permits. This function is presently properly being carried out by the Montana Department of State Lands and the Department of Interior.

Thank you for the opportunity to review these comments. If we can provide any information or can be of further assistance, please do not hesitate to call.

Sincerely,

Dave Simpson

David W. Simpson
Environmental Administrator

bjz
Enclosures

Use and Management of Soil for Range [1]

[1] Prepared by Sterle Dale, Range Conservationist, Soil Conservation Service.

In this subsection the soils of the area are placed in range sites. These sites and their vegetation are described. Also yields of forage are estimated for each site.

Rangeland is land on which the climax or potential plant community is composed principally of grasses, grasslike plants, forbs and shrubs valuable for grazing and in sufficient quantity to justify grazing use. In the Big Horn County area this native vegetation is present on 2,501,257 acres or about 78 percent of the total acreage of the area.

Cattle and sheep production is the main livestock enterprise. Cash receipts of 1969 agricultural products indicate that livestock and livestock products furnish about 66 percent of total cash sales. This indicates that rangeland soils produce the forage for a major part of the agricultural income of the Big Horn County area.

Roughly, the north half of the area receives precipitation averaging from 11 to 14 inches annually, while most of the south portion averages 15 to 19 inches annually. Some of the mountainous area receives precipitation in the 20" to 24" range.

Range Sites and Range Condition

A range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants. Soil mapping units are grouped into range sites according to their abilities to produce like kinds and amounts of native plants. Determining the kinds and amounts of plants growing on any specified range site is necessary in planning the management of that site. For example, it is desirable to know that an overflow range site receives water from flooding or runoff and is capable of producing an average kind and amount of native vegetation. By way of comparison, the gravel range site is capable of producing a much smaller amount of vegetation which is made up of entirely different plants. In the Big Horn County area most range sites differ in their management needs as well as in the number of grazing animals they can support.

Grazing animals are selective in their choice of plants resulting in heaviest grazing pressure on the most palatable plants. Close grazing use over a long period of time reduces the vigor of the choice plants and may eliminate them completely from the range site.

Before domestic grazing animals used the rangelands in the Big Horn County area, the plants that naturally grew on each soil represented the climax or potential vegetation for that particular soil. With increased grazing use, each kind of plant in the climax vegetation responded on each soil by becoming either more abundant or less abundant. Thus, taller, more productive, more relished plants normally decrease in abundance with continued excessive grazing use. These climax plants have been called decreasers. Similarly, the lower growing climax vegetation or those kinds less relished by livestock enjoy some advantages when the decreaser plants decline in abundance. Plants filling the voids have advantages for soil mosture, nutrients, and the like. As a result, the less demanding plants increase in abundance and replace weakened decreasers. These plants are called increasers since they respond to grazing pressures by increasing relative abundance.

With continued or prolonged excessive grazing use, both the decreaser and increaser plants tend to diminish from the vegetation. Again, another group of plants either native or exotic will usually fill in the space left by decreasers and increasers. These plants are called invaders and are usually characterized by being less relished because of spines, leathery texture, waxiness coarseness or bitterness. Invaders are frequently annuals or short lived perennials that are less dependable than the former decreasers and increasers.

Continuous overgrazing of a range site causes the composition of the plant cover to change from the highest kinds the climax and soils can support to lower unstable kinds.

In order to use the existing state of the vegetation as a tool in range management, the concept of range condition has been developed. Range condition is the present state of the vegetation of a range site compared to the climax or potential plant community of the range site. Relict areas and undisturbed areas provide the basis for determining the composition of the climax vegetation. For convenience, range condition can be grouped into range condition classes. Excellent range condition class is considered vegetation with 75 percent or more of the original or climax vegetation remaining. Good condition class ranges from 50% to 75%, fair 25% to 50%, and poor from 0 to 25% of original kinds and amounts of climax vegetation remaining. Thus, a timely inventory of quality and quantity of vegetation for each range site is available for guidance in management.

NORTHERN TESTING LABORATORIES

GREAT FALLS • BILLINGS MONTANA • BOISE IDAHO • GILLETTE WYOMING

Report of: Dustfall Analysis
Sarpy Creek Project

Date June 16, 1977
Job Number 72-179
Sheet 1 of 1

Report to: WESTMORELAND RESOURCES (3)
ATTN: MR. DAVE SIMPSON
P O BOX 449
HARDIN MT 59034

Sample Identification:

On June 6, 1977, five dustfall samples were delivered to our laboratory for analysis. The analysis was conducted according to ASTM D1739-70, "Collection and Analysis of Dustfall." The results are as follows:

TEST RESULTS:

te No. :	1*	2	3	4	5*
b No. :	4764	4765	4766	4767	4768
te Set Out:	4/11/77**	5/1/77	5/1/77	5/1/77	5/1/77
te Removed:	5/31/77	5/31/77	5/31/77	5/31/77	5/31/77
omponent, tons/sq. mile					
otal Soluble Settleable Particulates	7.26	4.68	4.52	3.55	47.26
otal Insoluble Settleable Particulates	13.86	8.73	3.47	6.56	77.26
otal Settleable Particulates	21.12	13.41	7.99	10.11	124.52
enzene Solubles	0.26	0.15	0.13	0.13	0.40
ombustibles and Volatile Particulates other than Benzene Solubles	2.86	2.18	1.02	1.32	6.95
otal Inorganic Particulates	20.86	13.26	7.86	9.98	124.12

*Sample contaminated with bird droppings
**Field technician indicated that this sample may have been exposed for two months.

Certified Tony G. O'Dell

NORTHERN TESTING LABORATORIES

GREAT FALLS • BILLINGS MONTANA • BOISE IDAHO • GILLETTE WYOMING

Report of: Dustfall Analysis
Sarpy Creek Project

Date July 20, 1977
Job Number 72-179-1
Sheet 1 of 1

Report to: WESTMORELAND RESOURCES (3)
ATTN: MR. DAVE SIMPSON
P.O. BOX 449
HARDIN, MT 59034

Sample Identification:

On July 6, 1977, six dustfall samples were delivered to our laboratory for analysis. The analysis was conducted according to ASTM D1739-70, "Collection and Analysis of Dustfall." The results are as follows:

TEST RESULTS:

e No. :	1	2	3	4	5	6
No. :	5311	5312	5313	5314	5315	5319
e Set Out:	6/2/77	6/2/77	6/2/77	6/2/77	6/2/77	6/2/77
e Removed:	7/6/77	7/6/77	7/6/77	7/6/77	7/6/77	7/6/77
ponent, tons/square mile						
al Soluble Settleable Particulates	13.23	16.94	15.97	9.84	9.84	9.36
al Insoluble Settleable Particulates	16.19	11.81	6.16	6.92	6.71	6.29
al Settleable Particulates	29.42	28.75	22.13	16.76	16.55	15.65
zene Solubles	0.18	0.23	0.15	0.40	0.11	0.13
bustibles and Volatile Particulates other than Benzene Solubles	7.92	6.55	3.60	2.98	2.82	2.47
al Inorganic Particulates	29.24	28.52	21.98	16.36	16.44	15.52

Certified Jay C. Lyndes

September 27, 1977

Mr. David W. Simpson
Environmental Administrator
Westmoreland Resources
P. O. Box 449
Hardin, MT 59034

Dear Mr. Simpson:

In accordance with the Department's Montana Environmental Policy Act rules (Rule V), you have been sent copies of all written comments received on the Absaloka Section 36 Expansion Draft EIS.

Before the Final EIS can be prepared, we are required to receive your/the applicant's response to the comments. As provided by the rules, you may elect to waive your right of response if you so desire. Our tentative schedule calls for issuance of the Final EIS no later than November 15, 1977. To meet this schedule, we would like to have Westmoreland's response or waiver on or before October 14, 1977.

Attached is a listing of comments received, by respondent and date, which have been transmitted to you.

If you need additional information or require clarification on any matters in connection with the final EIS, please feel free to contact me.

Sincerely,

Keith H. Corrigall
Environmental Coordinator

jb

Attachment

WESTMORELAND RESOURCES

COMMENTS ON THE
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FOR THE
PROPOSED EXPANSION OF
WESTMORELAND RESOURCES' ABSALOKA MINE
INTO
SECTION 36, T1N-R37E.

DSL RESPONSE TO LETTER

FROM

WESTMORELAND RESOURCES

	Page	Para.	Line	Comments:	
A	4	1	8	It should be stated here that the Final Environmental Impact Statement on the 20-year mining and reclamation was filed with the Council on Environmental Quality on May 31, 1977.	A. Your suggestion has been incorporated into the text.
B	4	1	Last	Range 37 East	B. The correction has been made.
C	5	2		Due to the comprehensive nature of the federal EIS's relative to the leases and 20 year mining plan, we feel that the amount of incorporation should be broadened. We suggest inserting in line 2 after the word indicated "or not otherwise contradicted".	C. Your suggestion has been incorporated into the text.
D	7			The table at the bottom of the page is confusing because it includes tonnage from Tract II also. Tonnages for Tract III from 1981 through 1986 should be 10 million tons annually, with 12 million tons in 1987, 14 million tons in 1988, and 15 million tons in 1989 to 1990.	D. The correction has been made.
E	9	1	3	"increasing" instead of "decreasing".	E. The correction has been made.
F	11	2	5-7	This sentence should be clarified. Only the south extension of cut #6 would not recover the Robinson seam. The Robinson seam will be recovered in the northern portion of this cut.	F. The sentence has been clarified.
G	12	1	2-6	This description of overburden placement is incorrect and confusing. Spoil from the first scraper pit will be placed north and east of Incline #4. Spoil from each successive scraper cut will be placed in the previous empty pit. Spoil from cut #1 would be placed in the mined out scraper pit area. Spoil from cut #2 would be placed in cut #1, and spoil from cut #3 would be placed in cut #2 in the southern portion and in the box cut spoils area east of Incline #4 in the northern portion.	G. The description has been rewritten.

	Page	Para.	Line	Comments:	
H	12	3	4	75 cubic yard dragline.	H. The correction has been made.
I	13	1	1	75 cubic yard dragline.	I. The correction has been made.
J	13	1	2, 3	If it was necessary to move the existing dragline to Section 36 due to a lack of Federal approval adjacent to the present mine area, we would not anticipate moving the dragline back to the north until the 20 year mining plan was approved and the second dragline was ready to begin operation.	J. The statement has been corrected.
K	13	List of Equipment		Until work in the scraper pit is completed, it will be necessary to have at least six scrapers. Also, please add one water truck to the list.	K. The additions have been made.
L	17	2	6-8	The fault system referred to may be more accurately described as a sag area or structural low since the displacement is not distinct.	L. The suggested reference has been made.
M	17	4	1	Capitalize "Crow"	M. The correction has been made.
N	19	1	4	The Stray 1 is also high in sulfur and ash.	N. Sulfur and ash have been added.
O	23	3	4-6	This statement regarding fugitive dust is intuitive and not based on available data; it should be qualified.	O. The statement remains unchanged. The reference is the Federal FES (20 year mining plan) page 58.
P	27	4,5		The descriptions of sampling stations for total suspended particulates are confused. Station #1 is correct, station #2 should be station #3. Station #3 should be station #2. In establishing station #2, high volume sampler from station #1 was relocated on the small rise of ground approximately 100' south of the water treatment building. Station #3, not station #2 was relocated to another site on Tract II.	P. The descriptions were rewritten to avoid confusion. As you stated, the station numbers were switched.
Q	27	Last	2-4	Please refer to total suspended particulate data included in the meteorology and air quality baseline report, April, 1975 to April, 1976, prepared by Dames & Moore dated June 18, 1976. This data also should be included in Table 9 on page 30.	Q. The remainder of Table 11 was added.
R	29	Footnote 2		"Protect" not "Protest" aesthetic values.	R. The correction has been made.
S	31	1		It should be pointed out that station #3 was in the mine area adjacent to an unpaved road and very near the crushing	S. The statement was footnoted to give the station's location.

	Page	Para.	Line	Comments:	
S				and handling facilities. One would reasonably expect high particulate concentrations in this area, and values exceeding ambient air quality standards at this location are not indicative of violations at the property line.	
T	31	4		Since responsibility for analyzing samples from dustfall canisters was transferred to Northern Testing Laboratories of Billings, Montana, early in 1977, we have found that the water used in the canisters prior to that time was a probable source of dissolved and suspended solids. We have begun using distilled water in dustfall canisters, and the readings for May, 1977, are much lower than most readings recorded previously.	T. No comment.
U	33	1		We suggest referral to the federal environmental impact statements for descriptions of the various soil series.	U. The reference has been made.
V	33	4		The comparison between Ft. Collins and Thedalund soils is somewhat misleading. Ft. Collins soils are associated with larger better developed drainageways. Thedalund soils occur most often in uplands, but are found in upland drainageways, particularly, when in combination with Wibaux soils.	V. Comments are noted.
W	37	2	3	It appears that "total dissolved solid" should begin a new sentence.	W. The correction has been made.
X	41	3	5-7	In most areas of Tract III, clinker has formed as a result of burning from the Rosebud-McKay coal seam. Since the Rosebud-McKay is burned away in these areas it does not underlie the clinker.	X. The word underlie has been replaced with contiguous since the recharge is lateral.
Y	45			Table 41 is repeated from page 44.	Y. The correction has been made.
Z	47	2	7-9	Figure 9B is a potentiometric map of the Robinson coal, and does not indicate that the interburden is saturated.	Z. The appropriate text has been reworded in order to explain it.
AA	47	3	2	Exponents on permeability figures should be negative.	AA. The correction has been made.

AB		In general comment, we feel that the transmissivity and permeability measurements for aquifers in the mine plan area should be put into perspective as to the amount of ground water indicated. For example, based on work conducted by the Montana Bureau of Mines and Geology, the coal seams in the Sarpy Creek area are much less permeable and hence transmit far less water than coal seams in other mine areas. A permeability figure of 2×10^{-6} centimeters per second is equivalent to 63 centimeters per year.	AB. The exponents have been changed to negative values. The Department agrees with Westmoreland's reference to data that has been collected from observation wells to date. However, the nature of coal hydrology is that water moves through fractures in the coal and moves more easily through more intensely fractured zones. It would be impossible to place wells in all the areas where greater fracturing has occurred. Therefore, if geologic information indicates a fold or fault is present it follows reasonably that increased fracturing of the coal resulted in greater water transmission capability.
AC	48	The description of "lush grass stands" intermingled with shrubs in wider valley bottoms is somewhat misleading. Both lower slopes and valley bottoms are vegetated primarily by a silver sagebrush - grassland type, with snowberry dominating along the coulee channels. If any "lush grasslands" are to be found, they are associated with seep areas and are highly localized, and so limited in extent as to be insignificant relative to the overall carrying capacity of the section.	AC. No comment.
AD	48 & 49	Moisture in Section 36 is so localized that moisture related plant communities are insignificant relative to the overall grazing capacity of Section 36. The tabulation of State grazing leases in Appendix D shows that areas with a source of water generally have a high carrying capacity, but many sections without a source of water listed also have relative high carrying capacities. Within a precipitation zone, the grazing capacity is related to soil capability and range condition. Vegetation measurements conducted by Westmoreland Resources in 1976 indicated a grazing capacity for Section 36 of 183 AUM's or .29 AUM's per acre. This places Section 36 just above average relative to the sections listed in Appendix D. This figure probably is high because high condition sites were sought for vegetation sampling. Productivity of Section 36 is related most directly to a preponderence of soils with the range site interpretations of silty and sandy. In 15 to 19 inch precipitation zone of Montana, silty and sandy range sites of a grazing capacity of .30 AUM's per acre with a condition rating of 75, a carrying capacity of this range site is .45 AUM's per acre.	AD. No comment.

AE AE	50 & 51	Wildlife		It should be pointed out in this section that wildlife habitats on Section 36 are typical of the entire upper Sarpy Creek drainage. The area of south facing scoria slopes in the southwest corner of Section 36 referred to in the last paragraph on page 51 is typical of burned or clinker areas. Examination of maps prepared by Ecological Consulting Service (1976) showed relatively few observations of mule deer in Section 36 compared to other portions of the study area. There were no winter mule deer observations reported in Section 36. We do not dispute that fact that mule deer utilize Section 36 during the winter. However, existing data do not indicate that Section 36 or any part of it is singularly important or critical.	AE. No comment.
AF				Antelope have been observed in Section 36; these are not listed in the EIS. In the 1976 report ECS does not show sharptail observations in Section; we have found observations of sharptails in this area to be unusual.	AF. No comment.
AG				We agree that the complexity of vegetation types in Section 36 and in the upper Sarpy Creek drainage generally is the basis for the value of the area as wildlife habitat. However, data collected by ECS do not show Section 36 to be a wildlife concentration area. Rather, they indicate that the opposite is true relative to the study area as a whole.	AG. No comment.
AH	56	2	1	"very" misspelled	AH. The correction has been made.
AI	56	3		The land values apparently given by the Big Horn County appraiser are not values for agricultural land. Presumably these figures assume presence of coal reserves and/or potential for industrial development. Even in this case, we feel these figures to be somewhat high.	AI. The figures were given to DSL by the county appraiser and remain unchanged.
AJ	56	Last	Last	The Absaloka mining operation has not resulted in a large influx of personnel. With the exception of some administrative personnel and those with special skills, most jobs at the mine have been filled from the local labor market, primarily the Crow Tribe. Therefore, we feel that "an influx of personnel" should be changed "an increase in employment".	AJ. The suggested rewording has been used.

	Page	Para.	Line	Comments:	
AK	57	4		Total employment at the mine has recently risen to about 140 persons, largely as a result of scraper operations in the southeast portion of the present federal permit area. Of this total, approximately 75 are members of the Crow Tribe or Crow related.	AK. No comment.
AL	62	2	Last	We presume that this refers to a statement made by Crow Tribal Chairman Patrick Stands Over Bull at the public hearing on Federal Environmental Impact Statement. In June, 1977, the Tribal Chairman wrote a letter to the Department of the Interior requesting prompt approval of Westmoreland Resources 20-Year Mining Plan. Due to differing opinions within the Tribe, we feel that it would be proper to delete this sentence and any other references to Tribal attitudes of this time.	AL. See response H to Friends of the Earth (Dobson) letter of July 22, 1977.
AM	63	Pollution & Traffic		It should be pointed out that this road is to be paved during 1977.	AM. The correction has been made.
AN	63	Blasting Effects		As of this time, Westmoreland Resources has not received any complaints regarding structural damage to buildings in the area as a result of blasting.	AN. No comment.
AO	67	Crow Agency	2, 3	"Big Horn River" should be "Little Big Horn River".	AO. The correction has been made.
AP	69	Lodge Grass	4	"Big Horn River" should be "Little Big Horn River".	AP. The correction has been made.
AQ	73	5	2, 3	"Optometry" and "optrometrist" are misspelled.	AQ. The correction has been made.
AR	79	3	6, 7	The word "Company" is not a part of the name of the Westmoreland Resources partnership.	AR. The correction has been made.
AS	79	3	3 lines from bottom	Hardin has a nine-hole golf course.	AS. The correction has been made.
AT	83	1		The majority of the mine area in Section 36 presently has a rolling topography. There are no maturely dissected areas with bluffs and steep slopes, although there are low scoria hills in the western and southern portions. With the exception of this broken topography, proposed post-mining topography will be similar to a pre-mining topography.	AT. Refer to changes in text.
AU	87	2		Leaching effects in topsoil stockpiles	AU. DSL agrees revegetation must be completed immediately.

	Page	Para.	Line	Comments:	
				should be mitigated by the revegetation of topsoil piles.	
AV	87	3		The leaching of trace elements by weathering is highly speculative. It should be pointed out that in order for elements to be released by weathering in toxic concentrations, they would have to be present in toxic concentrations in the first place. Such a problem has not been demonstrated by overburden analysis to date.	AV. The Department's "Red Flag Levels" for overburden constituents are based upon the criterion of plant availability which may not be reflected in lab analyses. Since the rate of weathering will increase with time due to an increased surface area to volume ratio, the rate of release of plant available trace elements will also increase. If the nutrient solution does not, at any given time, contain a trace element at toxic levels there remains another possibility. All or most of a trace element within the upper six feet of a soil profile may be concentrated within the upper 1'- 2' by soil water movement. We agree, however, that the actual likelihood of such an occurrence is speculative.
AW	88	Last		It is implied that Mrs. Vella Redding owns the lands in question. Westmoreland Resources has purchased all Redding lands within the boundary of Tract III.	AW. No comment.
AX	89	1		Recent measurements in the spring of 1977 have shown a flow from spring 237 of about one gallon per minute. The .1 gallon per minute rate was that reported by Wayne Van Voast. As a result of seasonal changes, fluctuations this great would not be unreasonable.	AX. The Department agrees with Westmoreland that variations in flow at spring 237 may be between 1 to 3 gallons per minute. However, flow rates of less than .1 gallon per minute described to the Department in an earlier letter, explaining the absence of flow values in the baseline information, are not reasonable.
AY	89	2	6, 7	Productive vegetation communities associated with seeps in the coulee bottom are very limited, with a total area of less than an acre within the entire section.	AY. No comment.
AZ	89	3		The drainage control system proposed by Westmoreland Resources is not accurately described in this paragraph. During the initial mining of Section 36, including scraper pit and dragline cuts 1 through 5, drainage will be controlled by 4 small impoundments in upland drainageways to the north of the main drainage. Two temporary impoundments would be constructed to the east of the highwall to control drainage from the highwall side. The primary sediment control pond (#5 or 6, depending on its final location) will be constructed prior to extention of cut #6. The recommendation contained in the last sentence of this paragraph has nothing to do with impact and should be deleted.	AZ. Refer to IV (B)(4)(a).
BA				The paragraph states that mining plans submitted do not provide adequate information to determine the effectiveness of the sediment catchment system. The catchment system will be adequate to detain	BA. Refer to IV (B)(4)(a).

	Page	Para.	Line	Comments:	
				runoff from at least a 10 year 24 hour storm as required by EPA regulations. Water would be impounded for sedimentation until water quality criteria specified in the discharge permit are met. If required by sediment accumulation, the sediment pond would be dredged to maintain its capacity. Therefore, we do not feel that this sentence is an accurate statement.	
BB	90	Last	2	The sediment control pond in the present mine area has been effective in controlling the discharge of sediment from the mine area; we expect that this will continue to be the case in Section 36. The last sentence in this paragraph is not properly placed in the impact section. Any discussion of discharge permit requirements should be placed in the mitigating measures section.	BB. Comments are noted.
BC	92	Last		This paragraph is highly speculative. Impact assessment should be based on the data which is available. Test wells in Section 36 are located within the structural low which presumably is referred to in this paragraph. We do not feel it proper to base an impact analysis solely on "jointing or fracturing that may have occurred," although the possibility certainly should be mentioned. The permeable Rosebud-McKay burn zone is present only in the western and southern portions of the Section, and will be mined only in the southern portion.	BC. The Department agrees that the paragraph is speculative. However, based on geologic evidence suggesting folding or faulting, the conclusion that increased jointing or fracturing resulted is reasonable. The ground water impacts of mining at the current mine location, which is both a topographic and a structural high area, quite likely will not be representative of impacts that will result in Section 36. Section 36 differs from the present location because it is a structural low and has a demonstrated thick saturated zone within the trough.
BD	94	2	5	A "variation in transmissivity" has not been demonstrated. This assertion should be qualified.	BD. The variation in transmissivity refers to clinker materials that will definitely have a different permeability than nonbaked materials at the original location of mining.
BE	95	2		This paragraph also is highly speculative. In the first place, this ash coulee bottom is within the Rosebud-McKay burnline, and hence cannot possibly be affected by clinker zones to the south. The presence of green ash, hawthorn, and american plum may be explained by subsurface water in the coulee bottom, or increased moisture as a result of overflow, aspect, or snow accumulation. The last sentence in this paragraph is incorrect. Springs 237 and 238 drain toward the coulee bottom from north to south, and do not cross the burn zone. This area is underlain by the unburned Rosebud-McKay coal.	BE. This paragraph is also based on an interpretation as discussed. Please note changes in the text.

	Page	Para.	Line	Comments:	
BF	95	Last	1	Sub-irrigated conditions are inferred based on the presence of the hawthorn ash plum-type of vegetation referred to above.	BF. No comment.
BG	96	2		The heading "Cumulative Impacts" is somewhat misleading. This section further describes site specific impacts of mining. Cumulative impacts will be those in addition to mining under presently approved permits. There are no significant cumulative impacts with other mine operations, since the nearest operation is at Colstrip, 20 miles to the east.	BG. The heading remains unchanged.
BH	97	4		There are no plans for leaving impoundment structures on the spoil surface.	BH. The correction has been made.
BI	99	2		Rather than "eliminating the competitive advantage of a species" we would suggest "altering the competitive status of some species".	BI. The suggested rewording has been made.
BJ	104	2	Last	It is not true that "any person moving to the area for the purpose of mining employment stands a fair chance of success". Members of the Crow Tribe of Indians are given preference in hiring at Absaloka Mine.	BJ. No comment.
BK	105	Last		County road 384 is to be paved during 1977.	BK. No comment.
BL	111	1		The protection of historic sites etc. now is the responsibility of the Montana Historical Society.	BL. The statement has been added to the text.
BM	114	3		As pointed out previously, the so-called violations of the air quality standards have occurred within the mine area in close proximity to roads and processing equipment. This does not relate in any way to air quality at the property line. Perhaps haul road watering should be increased; investigation of chemical dust retardants may also be adviseable. It is highly unlikely that the coal dust from the coal processing equipment at the load-out area is the prime source of air borne particulate matter in the mine area. Although some dust is generated by this equipment, the amounts are minimal due to covered conveyors, enclosed transfer points, and enclosed coal storage.	BM. No comment.

	Page	Para.	Line	Comments:	
BN	114	Last		Coal, not coal dust, is transported from the pit to the processing facility in haul trucks.	BN. The correction has been made.
BO	115	First	2	The coal processing equipment was constructed during 1973 and 1974, and it includes a number of features which serve to control dust. Whether or not "latest technology" by 1977 standards is included as open to question.	BO. No comment.
BP	116	4	2	Construction of impoundments on reclaimed surface may be feasible if some means of lining the bottom of the impoundment is utilized.	BP. No comment.
BQ	119	3	2	"Regeneration" probably would be a better word than "revegetation".	BQ. The word has been changed.
BR	121	Last		If there is the desire of the Department of State Lands to reclaim all or a portion of Section 36 with the primary objective of re-establishing wildlife habitat, Westmoreland Resources would be pleased to cooperate in such a program.	BR. No comment.
BS	123			A section should be included discussing production taxes and royalties which would be paid to the state, and used for mitigation of impacts. Approximate total anticipated revenues from Section 36 are: Royalties $ 6,125,000 Severance Tax 45,465,000 Gross Proceeds Tax 7,595,000 Resource Indemnity Tax 445,000 $59,630,000	BS. The table and discussion have been added to the section.
BT	126	Last		We believe that in the last sentence, the intent was to refer to the Robinson rather than the Rosebud coal. Exploration drilling to a depth of 600' has not shown the presence of any marketable coal seams below the Robinson.	BT. Please note change in the text.
BU	127	1		The effects of the losses of taxes and royalty revenue to the state and royalty revenue to the Crow Tribe should be discussed as a consequence of denial of additional mine permits.	BU. The statement has been added to the text.
BV	127	2		The environmental effects of opening a new mine as opposed to expansion of existing mine should be discussed.	BV. Because a new mine is not the subject of the EIS it is not an appropriate alternative to discuss.

	Page	Para.	Line	Comments:	
BW	128	2		There is no deep mineable coal within the Tract III area. Another point which can be made is the lower productivity in deep mining, hence requiring more people to move into the area. Deep mining would also produce lower tax revenues due to a lesser tonnage production at a lower tax rate.	BW. No comment.

Department of Health and Environmental Sciences
STATE OF MONTANA HELENA, MONTANA 59601

John S. Anderson M.D.
DIRECTOR

August 16, 1977

Mr. Brace Hayden
Department of State Lands
Capitol Station
Helena, MT 59601

RE: Westmoreland Resources Draft Environmental Impact Statement
for Section 36

Dear Mr. Hayden:

Attached you will find copies of comments from Duane Klarich and Richard Karp of this Department concerning the water quality aspects of the Final Environmental Statement (EIS) prepared by the United States Geological Survey, Department of the Interior: Proposed 20-Year Plan of Mining and Reclamation, Westmoreland Resources Tract III Crow Indian Ceded Area, Montana. The Water Quality Bureau feels that comments pertinent to the aforementioned EIS are also pertinent to the Draft Environmental Impact Statement for Section 36 prepared by the Department of State Lands.

The Department would appreciate the inclusion of the attached comments and the following into the final EIS drafted by your Department:

III. A. 4. Hydrology
(a) (two impoundments p. 89)
In the discussion of the impoundments, there is no mention of the impoundment that will receive water from the pit. A section should relate the volume of inflow expected in the pit to the size of the receiving impoundment. It is assumed that impoundment #5 or #6 will be the final impoundment that will collect water from the project area and the pit and will be the discharge point to be considered for a discharge permit. The structure at this location should be constructed prior to the development of the pit.

An alternative proposal could be utilization of the smaller reservoirs if they can be shown to be of adequate design to contain pit water run-off and any waters containing blasting residue.

DSL RESPONSE TO LETTER

FROM

MONTANA DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

Westmoreland has provided additional storage above that required by E.P.A. in the final impoundment that will receive discharge from the pit. New data recently generated provides a better understanding of the depth of saturation, and pumping data currently being developed will enhance our knowledge of transmissivities and therefore, expected inflow to the pit. Based on this new information the current design for the final impoundment will be reevaluated. The possibility exists that the interim regulations for the new Surface Mining Control and Reclamation Act of 1977 will require discharge to meet effluent limitations under conditions of a 25 year 24 hour rainfall event which would require a change in design for the Westmoreland proposed impoundments.

We wish to apologize for the tardiness of our comments and would like to request that in the future, the Department of Health and Environmental Sciences, Water Quality Bureau, be placed on the list of agencies receiving Draft and Final Statements prepared by your Department.

If you have any questions involving the above submittal, please feel free to contact this office at 449-2406.

Sincerely,

James E. Rasmussen

James E. Rasmussen
Public Health Engineer
Water Quality Bureau

JER:nn

Enclosure

Comments on the EIS: Dick Karp

Proposed 20 year plan of Mining and Reclamation Westmoreland Resources Tract III, Crow Indian Ceded Area, Montana

1. Water quality problems will arise due to a dewatering of the sarpy creek watershed directly below the proposed mining area. The dewatering will result from the entrapment of runoff water and intercepted groundwater in the mining area. The effect of the dewatering will be that of raising the concentration of dissolved constituents in the watershed below the mining area, since the surface runoff component (a diluting factor) will be reduced. Also lower stream flows generally result in larger percentages of evaporation which also tends to increase the concentration of dissolved constituents. The extent of the increase will be largest directly below the proposed mining area. This increase in concentration may result in water unfit for the present uses. The majority of present uses include livestock and wildlife water supply, and limited irrigation. The irrigation use is mainly for flood irrigation of small acreage hay fields adjacent to streams. A certain flow of acceptable quality water for these uses may be required from the impoundment in the mining area to alleviate any downstream degradation.

RESPONSE TO COMMENTS BY DICK KARP

1. Comments are noted. The statement that increased concentrations of dissolved constituents may result in surface water quality unfit for present uses is speculative. It is possible that stream flow will suffer the described loss of quality however without any information on spoil water quality relative to the Absaloka Mine site this statement is premature.

2. Since the major present uses of water in the area are livestock and wildlife water supply and flood irrigation, the monitoring requirements of the Westmoreland discharge permit should reflect the concern for water quality maintenance pursuant to these uses. For example:

Livestock and Wildlife Water Supply
- TDS or EC
- SO4
- HCO3
- Na

Irrigation Water Supply
- TDS or EC
- SAR
- HCO_3
- Boron

Duane A. Klarich
August 5, 1977

Review of Final Statement prepared by the United States Geological Survey, Department of the Interior: Proposed 20-Year Plan of Mining and Reclamation, Westmoreland Resources Tract III, Crow Indian Ceded Area, Montana

Attention in this review will be directed primarily to surface water hydrology-water quality.

II. Description of the Environment-Hydrology

No major comments are directed to the "Surface Water" section in the Statement. It should be stressed that the streams under consideration in the upper Sarpy Creek drainage are extremely small with typically low flows outside of runoff events. Several uses of these waters are listed in the Statement, although a discussion of current water quality in relation to the uses is not presented in this section; such relationships between water quality and water use are considered to some extent in the attachment to this review.

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2. This comment refers to a discharge permit which is administered through the Water Quality Bureau.

RESPONSE TO COMMENTS BY DUANE A. KLARICH

II. Comments relative to the Description of the Environment are acknowledged.

The summary presented in the "Surface Water Quality" section appears to be valid although quite general in nature. Additional information of this kind is included in the Attachment. The generally poor quality of water in the upper Sarpy Creek drainage is particularly notable. Although there is a general downstream improvement to the stream's mouth, water quality remains relatively poor throughout the length of the stream. This poor quality appears to be related primarily to natural consequences, and it is characteristic of most small prairie streams in eastern Montana. The relationships between flow and dissolved solids (DS) levels described on pages 86 to 87 of the Statement have been observed in other small streams of this region. However, the inverse relationship between flow and DS is less distinct and consistent in these smaller streams such as Sarpy Creek than the case for the larger systems such as the Yellowstone River. Thus, a poor quality of water can be obtained during certain periods of high flow in these creeks. As stated on page 91 of the Statement, waters with high concentrations of dissolved solids and nitrogen species are projected to accumulate in the mining pits of the project area as intimated by analyses from the Big Sky Mine near Colstrip. It should be noted that high DS concentrations have been consistently found in the streams of the project area while uniquely high nitrogen levels have been sporadically observed in these waters (see Attachment). For the most part, salinity and the associated high concentrations of various ions appear to be the major water quality problem in the Sarpy Creek drainage potentially affecting or altering many water uses; suspended solids would appear to be a minor problem at the present time with the possible exception of brief intervals during runoff periods.

The Statement lists several sources of "low level" pollution to the streams of the project area. These are described as largely non-point in character, and this probably represents the most likely case for the region. Some potential pollutive inputs to the streams appear to be reflected in certain of the water quality parameters, and these are described in the Attachment.

III. Environmental Impact of the Proposal-Hydrology

No comments will be directed to the "Surface Water" and "Ground Water" sections. The Statement suggests that the proposed mining operations " . . . will have some adverse effect upon the quality of surface and ground waters within and adjacent to the mine site." Given the saline nature of the streams at the present time, additional quality degradations will probably be most pronounced and obvious in terms of enhanced suspended solids concentrations and trace element levels unless adequate control measures are applied. With the alkaline nature of the waters in the region, acid-mine drainage does not appear to represent a problem. Slight increases in the dissolved solids and alkalinity levels of the stream as a result of the mining operations will probably not significantly degrade an already poor quality of water relative to most uses. Increased trace element concentrations could represent a more significant problem since the dissolved levels of these parameters do not appear to be markedly high at the present time. In addition, increased erosion from the works at the mining area could noticeably increase the suspended sediment concentrations of the streams, particularly during runoff events; this would constitute a significant quality degradation since the streams of the project area for the most part now lack high levels of this particular variable for a large part of the year. The detention ponds described in the Statement should largely mitigate this potential problem.

III. Environmental Impacts - "Given the saline nature of the streams at the present time, additional quality degradations will probably be most pronounced and obvious in terms of enhanced suspended solids concentrations and trace element levels unless adequate control measures are applied."

Sediment detention structures should be effective in controlling suspended solids concentrations until reclamation areas have stabilized and bond has been released. Potential problems with increased trace element levels cannot be predicted at this time. As spoil materials resaturate, water quality will be evaluated and problem areas defined.

Additional comments on impacts to water quality and their relative significance are acknowledged. The Department will consider BOD5 and COO for inclusion with parameters currently being analyzed for in the surface monitoring network.

Relatively high nitrogen and organic (e.g., BOD_5 and COD) levels have been obtained from the streams in the project area (see Attachment), and these aspects were not mentioned in the Statement. Although these problems appear to be minor at the present time, if these features are related to current strip mining activities in the region, some attention should be directed towards alleviating these problems before they constitute a major impact to the streams.

IV. Mitigating Measures Included in the Proposed Action-Water Quality

Given the potential for water quality degradation in Sarpy Creek as a result of strip mining activities on its upper drainage, extensive control measures for wastewaters related to the mining are described in the Statement; these measures include interceptor and internal drainage systems, detention and settling ponds, chemical precipitation, proper waste disposal, and release to natural drainages only upon appropriate dilution in accordance with State standards. The pollution abatement program described in the Statement would appear to be adequate to reduce potential water quality impacts upon the streams of the project area, but the proof of this effectiveness will reside in future operations and the results of an adequate monitoring program. The water quality monitoring stations presented in Figure 19, page 93, appear to be sufficient for these purposes, and a monthly sampling program through the course of the mining project is advised for those stations located in a downstream direction from the mining area. In addition, continuous monitoring of at least specific conductance and flow is advised to assist in identifying the occurrence of ephemeral slugs of materials that might enter the natural drainage from the mining area. Special sampling should also be made in relation to major storm and runoff events to ensure that the detention and drainage systems within the mining area are operating satisfactorily.

IV. Mitigating Measures - "The water quality monitoring stations presented in Figure 19, page 93, appear to be sufficient for these purposes, and a monthly sampling program through the course of the mining project is advised for those stations located in a downstream direction from the mining area."

Westmoreland is currently conducting the monthly sampling program described.

The inclusion of continuous monitoring of specific conductance will be considered by the Department.

Less frequent monitoring of the stations above and within the project area would probably be satisfactory. In addition to the parameters summarized on page 346 of the Statement, ammonia-nitrogen, nitrate plus nitrite-nitrogen, and some measure of organic concentrations such as COD, BOD5, or TOC should also be monitored in view of the penchant for the upper drainage to have high levels of these variables.

Department of Health and Environmental Sciences
STATE OF MONTANA HELENA, MONTANA 59601

AIR QUALITY BUREAU
Cogswell Building
(406) 449-3454

A. C. Knight, M. D.
Director

August 3, 1977

Environmental Coordinator
Department of State Lands
Capitol Station
Helena, Montana 59601

Gentlemen:

The Montana Department of Health and Environmental Sciences (MDHES) appreciates having the opportunity to comment on the draft environmental impact statement entitled "Draft Environmental Impact Statement for the Proposed Expansion of Westmoreland Resources, Inc., Absaloka Mine into Section 36, T1N, R37E", which was released June 24, 1977.

As discussed in detail below, our concerns are in the following areas:

1. The air quality data included does not present a good picture of present conditions in the Sarpy Creek area.
2. The data shows that violations of ambient air quality standards are now occurring in the area. Should an expansion be considered in this case?
3. A production rate increase will aggravate the already poor air quality.
4. Best available control technology is not in use at the coal processing facility.
5. The discussion of mitigating measures for TSP should be expanded.

The suggestion to include additional parameters and increase the frequency of analyses relative to discharges is properly implemented through the discharge permit.

6. The prevention of significant deterioration and air quality maintenance planning portions of the Federal Clean Air Act were not considered.

The Air Quality Bureau has reviewed the air quality portions of this document and has concluded that the data on air quality is inadequate.

A. Table 11 lists TSP data from Westmoreland high volume sampling stations 1-4. This data shows one occurrence at Station No. 2 where the TSP concentration exceeded the state 24-hour standard and the federal secondary standard. At Station No. 3 the federal secondary standard was exceeded six times, the Montana 24-hour standard was exceeded five times and the federal 24-hour standard was exceeded three times. Stations 1 and 2 are up-wind of all mine activity except for train movement most of the time. Station No. 3 was admittedly close to the truck dumping area and some high values of TSP would be expected. Station No. 4 located somewhere on Tract II is indicative of background concentrations of TSP. Nowhere in Table 11 are any data presented to indicate ambient air concentrations of TSP down-wind from the mining operation. Based upon the meager amount of TSP data presented and knowledge of conditions at other coal mines in Montana, it is our position that violations of ambient TSP standards are occurring down-wind from the mining operation.

B. Table 12 shows many violations of both of the state settleable particulate standards. Insufficient data on the location of these sampling stations and sources of settleable particulate matter close to these stations is presented.

The area monitoring efforts have been insufficient. To correct this problem and to build a good data base for the future, minimum requirements are presented below.

C. Westmoreland Resources shall be required to perform air monitoring in and around the mining areas. Such monitoring will evaluate and correlate air quality, meteorology and mine activity parameters.

As a minimum, the monitoring will:

1. Include four hi-vol (TSP) samplers which somewhat transect the mine area in the prevailing wind direction. Approval for these sampling sites will be given by the AQB. Midnight to midnight, one-in-six day samples will be required with data collection being greater than 90% for all four quarters of the year. Quality Assurance will follow EPA reference methods (EPA-R4-73-028b June, 1973) and Air Quality Bureau (AQB) calibration procedures.
2. Include six perimeter dustfall stations around their present mining operation. The ASTM method D 1739-70 should be used.

DSL RESPONSE TO LETTER
FROM
AIR QUALITY BUREAU
DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
STATE OF MONTANA

A. Table 11 in the draft EIS contained only a partial years record. Table 11 in the final EIS has been changed to reflect a years period. The factual determinations as to whether air quality standards violations are occurring downwind from the mining operation is a matter for the Air Quality Bureau to determine as part of their responsibilities for regulation and enforcement of Montana's air quality laws and regulations. If violations can be legally documented as being caused by the mining activity, DSL assumes that DHES will take the necessary action to enforce the statutes. A lack of such action can only indicate a lack of evidence to conclude that a violation has occurred.

B. Location of the stations is described in the text of the draft EIS at page 31.

C. For additional clarification and explanatory information on both comments A and B above, refer to applicant's (Westmoreland Resources) letter of August 11, 1977 at item 10, page 13 contained in this EIS. The Department of State Lands will require, as a condition of the permit if approved, that Westmoreland initiate and maintain an air quality monitoring program. The scope, terms and conditions of this program is essentially that proposed by the Air Quality Bureau in comment C. Also Westmoreland has committed

3. Supply AQB a monthly report in a specified format which includes the following: a. mass loading, TSP b. color hue or intensity c., d., e., mine activity parameters f. water applied to area g. blasting h. precipitation i. mean wind speed j. mean wind direction k. ambient temperature l. dustfall m. dustfall organic content n. soil erodibility potential 4. State the number of invalid samples taken per month. 5. Include a met station which will give hourly wind speed and direction at 10 meters height; provide daily precipitation and temperature data. 6. Initially perform a general sampling station inventory as per AQB guidelines and update as necessary. 7. Insure high quality data collection by following state and federal quality assurance procedures and perform within AQB field audit ranges. 8. Be re-evaluated on a two-year basis. Such reviews could be conducted in conjunction with AQB coal handling equipment operating permit renewals.	itself to establishment of a monitoring program that will meet the Air Quality Bureau's requirements This commitment is evidenced by the statement of Westmoreland contained in their letter of August 11, 1977 at page 15.
D. The environmental statement indicates a proposed production rate increase from about 4 to 19 million tons of coal per year by 1990. If the mine production increases, the amount of mining equipment necessary would also increase. Use of the existing coal loading facility would also increase. If the activity at the mine increases, it is logical that the concentrations of particulate matter in the ambient air and the number of violations of both state and federal ambient air quality standards for TSP would also increase.	D. The forecast or speculation contained in the comment does not necessarily follow if adequate air quality standards and regulations are enforced by the appropriate regulatory federal and state agencies.
E. On page 115, the statement is made that dust control measures incorporating latest technology are included in the design of crushers, conveyors and loading facilities. This statement was derived from one of the references. It is not true. For example, the conveyors are partially covered but not enclosed. The car loading operation is not enclosed, although we know of no other facility that does enclose a portion of the train being loaded. Coal-dust laden air is moved to the outdoor atmosphere by fans without using control devices. Conveyor head pulleys are enclosed but no air pollution control devices are connected to the hoods around these head pulleys. An open chute discharges oversize material into an open truck so that this material can be returned to the primary crushers. No water sprays are used on any of the conveyor belts or other equipment.	E. No comment is required. Refer to letter of August 11, 1977 from Westmoreland Resources on pages 16 and 17.

Two possible control schemes that are mentioned are watering of the roads and vegetation of soils as soon as is practicable. These are not the only ways to reduce emissions from a mining operation and we believe that this section should be expanded to discuss all of the operations at a strip mine which cause emissions of particulate matter and other pollutants into the atmosphere. Specific operations which should have been discussed but were not are topsoil removal, blasting, coal removal, coal handling and storage, overburden replacement, topsoil replacement, and seeding.

The responsibility of the Air Quality Bureau is to insure that state emission standards and both state and federal ambient air quality standards are achieved or maintained within Montana. Violations of both federal and state ambient air quality standards have occurred. Therefore, in keeping with our objectives, we cannot condone a mine expansion unless mitigating measures are incorporated into the mining plan which will insure attainment and maintenance of the applicable standards. The environmental statement does not address the prevention of significant deterioration section of the Federal Clean Air Act, nor does it discuss air quality maintenance in progress by the MDHES. The policy of the MDHES is that best available control technologies should be applied to sources of air pollution. Even though Montana does not now license strip mines, we feel that this philosophy should be applied to the mine. Montana does require construction and operating permits for coal handling facilities and it is our intent to require best available control technology on these facilities. We believe that the Air Quality Bureau should review the company's mining plan to insure that best available techniques are employed to minimize air pollution. We also believe that these techniques should be incorporated as conditions of the permits issued by the Montana Department of State Lands.

Again, we thank you for being allowed to comment on this document.

Sincerely,

Fred O. Gray

Fred O. Gray
Environmental Engineer

FOG:kh

cc: Ed Wadington
Tom Ellerhoff

The Federal Clean Air Act Amendments of 1977 (act) significantly changed the requirements for the prevention of significant deterioation of air quality (PSD). Very generally, the list of affected sources was increased from 19 types to 28 specific types and one "catch-all" type which includes "any other source with the potential to emit two hundred and fifty tons per year or more of any air pollutant." This last type will probably include all new coal mines and certainly all existing mines in Montana which increase production by an amount which in turn increases the emission rate of any air pollutant by 250 tons/year. The act changes also include the possibility of obtaining a variance from the requirements under certain circumstances, visibility requirements for federal Class I areas, changes to the allowable increases in pollutant ambient air concentrations, changes in the requirements for automatic inclusion in Class I and requirements for the adoption of PSD rules for pollutants other than sulfur oxides and particulate matter.

The EPA is required to adopt rules implementing the requirements of Section 165, Preconstruction Review, within 6 months. This should be completed by the spring of 1978. Since a PSD permit issued by the EPA under this law must be reviewed according to rules which have yet to be adopted, the EPA is considering the effective date of this section to be whenever these rules are adopted. Quite possibly this interpretation could be the basis of litigation against the EPA by environmental or other organizations. Therefore, it appears at this time that Westmoreland Resources will not be subject to the PSD requirements of the act if construction is commenced as defined in the act prior to the effective date of Section 165.

STATE OF MONTANA

DEPARTMENT OF
FISH AND GAME

P.O. Box 430
Miles City, MT. 59301
June 27, 1977

Environmental Coordinator
Department of State Lands
Capitol Station
Helena, MT. 59601

Gentlemen:

A. After having reviewed the Draft EIS for the Proposed Expansion of Westmoreland Resources, Inc., Absaloka Mine into Section 36, T1N, R37E, I concluded that the vegetation and wildlife sections appear to be satisfactory. The most important point is that this area is quite diverse vegetatively and supports a wide variety of native wildlife species.

B. The Impact Section was quite realistic in stating that vegetative diversity may never attain the level the area had prior to mining. In light of this, the Department of State Lands suggests in the EIS several mitigating measures (page 120) for the company to take. These suggested mitigating measures are indeed commendable; however, I believe that the company should make a strong committment to adhere to these measures before the mining plan is approved. Such an action would underscore the sincerity of the company's reclamation efforts and reaffirm their desire to conform to Section 50-1045 (a) of the Reclamation Act.

Thank you for the opportunity to review this statement.

Sincerely,
Robert R. Martinka
Robert R. Martinka
Project Leader
Coal & Energy Studies

cc: Jim Posewitz

OSL RESPONSE TO LETTER
FROM
DEPARTMENT OF FISH AND GAME
STATE OF MONTANA

A. No response required.

B. Westmoreland Resources has committed itself to the restoration and reclamation of the proposed permit for both wildlife habitat and domestic livestock grazing purposes. Prior to approval of the mining and reclamation plans the OSL will incorporate adequate provisions for the restoration of wildlife habitat on the permit area. The Department of Fish and Game will be requested by DSL to provide input into the formulation of the wildlife habitat portion of the reclamation plan stipulations, terms and conditions. Prior to approval of any reclamation plans OSL will also consider the applicability of the provisions of Section 50-1042 of the Reclamation Act to the permit area.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
1860 LINCOLN STREET
DENVER COLORADO 80203

JUL 2 6 1977

Ref: 8W-EE

Mr. Brace Hayden
Environmental Coordinator
Department of State Lands
Capitol Station
Helena, Montana 59601

Dear Mr. Hayden:

The Environmental Protection Agency (EPA) has reviewed the draft EIS for the Proposed Expansion of Westmoreland Resources, Inc., Absaloka Mine into Section 36 by the Montana Department of State Lands. Our concerns for this entire project, including Section 36, are stated in our comments on the final EIS on the Proposed 20-Year Plan of Mining and Reclamation, Westmoreland Resources Tract III, Crow Indian Ceded
1 Area, Montana. Although our comments on that EIS concern the entire project, the State should consider those comments in making their decision on Section 36. We would also like to note that the information in the Memo in Appendix C is well taken. Regarding your EIS, we would like to know if the option of using Montana's Section 9, Selective Denial Clause, has been considered.

Sincerely yours,

John A. Green
Regional Administrator

OSL RESPONSE TO LETTER

FROM

U.S. ENVIRONMENTAL PROTECTION AGENCY

(July 26, 1977)

1. "Regarding your EIS, we would like to know if the option of using Montana's Section 9, Selective Denial Clause, has been considered."

Section SO-1042 has been thoroughly evaluated with regard to mining in Section 36. Two aspects of the selective denial clause may apply to the situation in the section.

The portion of Section SO-1042 stating, "The Department shall not approve the application for ... strip mining ... where ... mining ... on that area would adversely affect the use, enjoyment or fundamental character of neighboring land having special, exceptional, critical or unique characteristics" may apply to the situation described under III (A) (4) (b) (1). There is a possibility that spring 277 on the East Fork of the Sarpy Creek side of Tract III may be impacted as a result of lowering ground water storage in the trough. An evaluation of the area surrounding the East Fork springs has not been made at this time, so any impact on the springs may affect a Section 9 determination of the area at a later date.

Part (2) (b) of Section SO-1042 states, "... land is defined as having such characteristics if it possesses special, exceptional, critical or unique ... ecological fragility, in the sense that the land, once adversely affected, could not return to its former ecological role in the reasonable foreseeable future." The debate

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1860 LINCOLN STREET
DENVER COLORADO 80203

JUL 2 6 1977

Ref: 8W-EE
F-IGS-J01009-MT

Mr. Henry W. Coulter
Acting Director
U.S. Geological Survey
U.S. Department of the Interior
Reston, Virginia 22092

Ref: EGS-Mail Stop 760

Dear Mr. Coulter:

The Environmental Protection Agency (EPA) has reviewed the final environmental impact statement (EIS) on the Proposed 20-Year Plan of Mining and Reclamation, Westmoreland Resources Tract III, Crow Indian Ceded Area, Montana. Since the draft EIS comment period closed, several members of our staff have visited the site and have contacted the U.S. Geological Survey (USGS) for more detailed information. Although the hydrologic material presented in the draft EIS appeared adequate, it has become apparent that the document did not portray the complexity of the system. The additional information obtained by our staff indicates that the ground and surface water conditions in this area deserve more attention than they have been given. The attached memo describes in detail the findings of our staff concerning the complexity of this system. Also, the final EIS did not adequately address our comments on the draft EIS. In particular, there are two areas that we feel were not adequately addressed by the USGS: a water resources management scheme and the quantitative and qualitative estimates of post-mining water resources.

2 There is no management scheme to provide water to the area after
it is mined. Although Westmoreland has made a commitment to the replace-
ment of lost water supplies, probably from wells in the sub-Robinson unit,
3 deeper wells have not been demonstrated as adequate replacements for near
surface ground water springs and wells in terms of either quantity or
quality. In addition, operation and maintenance procedures should be
spelled out for wells, storage tanks, and other portions of the post-
mining water supply systems. It also seems appropriate and necessary to
provide more detailed projections of post-mining land use in terms of
grade, drainage, and provisions of water to support planned uses. We

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surrounding this clause is whether the moist shrub types in the coulee bottoms and ponderosa pine can be replaced after mining. Westmoreland should be commended for purchasing a tree spade that will give the best possible chance for establishment of these trees and shrubs. The ultimate question is whether the plants once established can reproduce. There is no information available that we know of to answer this question.

In summary Section 9 has been considered with regard to the Section 36 application however a final decision has not been made.

DSL RESPONSE TO LETTER

FROM

U.S. ENVIRONMENTAL PROTECTION AGENCY

(July 26, 1977)

2. "There is no management scheme to provide water to the area after it is mined."

Replacement of a water source in Section 36 is described in the text under IV (B) (4) (a). Westmoreland will be required to provide a power source and storage for the stock watering system.

believe the management scheme for replacing lost water is necessary prior to mining plan approval because mining in Tract III will have deleterious impacts on the water resources of the mined and adjacent areas and could adversely affect alluvial valley waters and their adjacent areas in East Sarpy Creek Basin. The existing system of springs and seeps requires special post-mining management considerations; further detailed comments on this subject are contained in the attached memo.

4 The other area that we feel the USGS did not adequately address relates to quantitative estimates of post-mining ground water conditions and post-mining water quality. The EIS should contain a post-mining potentiometric map for the replaced overburden showing drawdowns from the original overburden and Rosebud-McKay water levels. General estimates should be given for lowered water table levels in and adjacent to the mine area. In addition, estimated post-mining transmissivities and permeabilities should be presented. The information is needed to assess the availability of water necessary for support of the planned post-mining land uses. Such an assessment also requires more quantitative post-mining ground water quality information. Also, more detailed information is needed with respect to the ground water contribution effect on the water resources of subirrigated areas of the East Fork.

Because of the interrelated system of springs and subirrigated areas in the proposed mining area of Tract III, the lack of a post-mining water management plan, and the lack of more detailed hydrologic information for on- and off-site impacts, we feel the measures necessary to minimize hydrologic disturbances and to establish post-mining land uses are insufficiently understood at this time. There are, in addition, other considerations that could affect this proposed action.

- The possibility of trading federal deep-mine coal revenues to the Crow Indians for the Crow ceded coal in the proposed mining area of Tract III is being considered by the Department of Interior.

- Alluvial valleys and adjacent areas in East Fork Sarpy Creek could be adversely affected; the mining of such areas is being addressed in the present legislative session of Congress.

- The State of Montana has the option of utilizing their Section 9, Selective Denial Clause, for the State-owned lands (Section 36). They have written a State EIS concerning these lands.

- The possibility of mining Alternative Area 2 has not been addressed by the USGS in the EIS.

3. "Deeper wells (referring to the sub-Robinson unit) have not been demonstrated as adequate replacements for near surface ground water springs and wells in terms of either quality or quantity."

A sub-Robinson well has been used for domestic purposes in the Tract III area and a complete review of all water quality data on sub-Robinson wells for the Tract III area reveals water from this aquifer zone is not ideal but is usable for stock watering purposes. Sulfates and dissolved solids were parameters found in moderately high concentrations in the sub-Robinson waters however, only one of 32 wells evaluated had dissolved solids concentration of 4,000 mg/l which is approaching the 5,000 mg/l recommended limitation for stock watering (Water Quality Criteria, 1972). Only 3 of the 32 wells examined contained dissolved solids concentrations over 3,000 mg/l which is the recommended safe limit under most any circumstances.

A well has been drilled to the sub-Robinson recently in Section 36 and the suitability of the well to produce an adequate quality and quantity of water for stock use will be evaluated prior to permit issuance.

4. "... the U.S.G.S. did not adequately address ... quantitative estimates of post-mining ground water conditions and post-mining water quality."

EPA has environmental reservations about this project because of the concerns outlined above and in the attached memo. Therefore, EPA believes the mining plan should not be approved until a suitable water management plan is developed and further hydrologic studies are undertaken. This course of action would keep all of the options open until some of the unresolved issues have been decided upon and until the complex hydrogeological system is more thoroughly understood.

We appreciate the time and effort the USGS staff has given our staff in conducting a review of this project. If you have any questions about these comments, please don't hesitate to call this office.

Sincerely yours,

John A. Green

John A. Green
Regional Administrator

United States Department of the Interior
GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

In Reply Refer To:
EGS-Mail Stop 108

AUG 9 - 1977

Mr. John A. Green
Regional Administrator
U.S. Environmental Protection Agency
1860 Lincoln Street
Denver, Colorado 80203

Dear Mr. Green:

We are in receipt of your letter of July 26, 1977, Ref: 8W-EE F-IGS-J01009-MT, providing comments on our final environmental statement on the 20-year Plan of Mining and Reclamation, Westmoreland Resources, Crow Ceded Area, Montana. (FES 77-17).

Due to the fact that very little ground water has been intercepted at the existing mine there has been no attempt made to evaluate post-mining ground water levels, permeabilities nor ground water quality in presumably dry spoil materials. General experience has been gained from other mines as described in the text, however any attempt to quantify post-mining groundwater conditions would be largely conjecture.

DSL RESPONSE TO LETTER

FROM

U. S. GEOLOGICAL SURVEY

AUGUST 9, 1977

No Response Required

We have re-examined our responses to your comments on the draft statement, and find that they address all points raised, and are as responsive and specific as the data and state-of-the-art in hydrologic analysis permit at this time. As acknowledged in your staff's investigative memo of June 13, 1977, appended to your recent letter, the analyses you insist be undertaken are presently at or beyond the state-of-the-art. We anticipate that present research and data collection activities by Government agencies and industry will provide a sufficient body of data to improve that capability in the near-term. In this connection, we wish to advise you that the Area Mining Supervisor, Geological Survey, may, at any time, require reasonable modification of any phase of an approved mining and reclamation plan where he determines it is necessary or desirable for efficient, environmentally sound mining operations.

We have received comments on the final statement from three Montana State agencies. None of these agencies raised issues that parallel the issues raised by you.

With regard to preparation of a water management scheme to provide water to the project area after mining, we are unaware of explicit or implicit requirements in Federal statutes or regulations to provide such a scheme. Indeed, it is not possible to comply with certain aspects of your suggestions, given the state-of-the-art as acknowledged by your staff.

As noted in both draft and final statements, Westmoreland is the owner of essentially all of the land surface in this project area.[1] Thus, the Company should not be deemed obligated to restore to itself such existing water supplies that may be destroyed by the mining it proposes to undertake. As you acknowledge, Westmoreland has made a commitment to replace lost water supplies of off-site owners so affected. Although we will rely on the concerned agencies of the State of Montana to provide you with authoritative interpretations of their statutes and regulations, we understand that Westmoreland would be obligated under State law to replace water supplies of other owners of land to be mined, or water supplies of off-site land owners whose loss or damage can be attributed to the proposed operations.

With regard to your insistence for more detailed projections of post-mining land use, we believe the proposed plan to be in conformance with applicable Federal regulations and the lease terms, and appropriately detailed with respect to final surface grades, drainage, and re-vegetation plans and research programs. As discussed at considerable length in this environmental statement, water supplies to support such use are readily available on-site from sub-Robinson aquifers, should supplies not be readily available from shallower depths in the post-mining ground water regime that will be established in reclaimed areas. The fact that Westmoreland owns virtually all of the land surface in question is also germane to the discussion of the issue of post-mining land use.

With respect to your concern that there are other considerations that could affect this action, we wish to state that:

- The final statement addresses the alternative of exchange of Federal coal for the leased Crow coal in question.

- The final statement takes note of the pending Federal legislation and the possibility that if passed, the proposed plan may require modification to conform thereto.

- The Montana authorities will, we believe, diligently exercise their prerogative and fully and appropriately consider all options in their decisionmaking process. In this regard, you will note that the draft and final statements on the proposed mining and reclamation plan were provided directly to the Montana State Land Department and other State agencies. The Land Department offered no written comment on either document, and we are free to assume that they found no substantive faults therein. (See CEQ Guidelines.)

1/ Westmoreland does not own the surface of, but has leased one section of State coal, which is the subject of a State EIS under preparation. An additional ½ section is not yet owned by Westmoreland, but the Company holds an option to acquire ownership, and proposes to exercise that option in the next several years. This ½ section is not scheduled for coal mining under the proposed plan until the mid and late 1990's.

- The general alternative of mining areas of the tract other than that proposed, as well as sources other than Tract III are considered in Section VIII of the statement, and in Section VIII of the lease-wide evaluation contained in the companion BIA statement, FES 76-64. The potential mining of Alternative Area 2 is discussed in the final EIS for the proposed mining plan (See Sections I and VIII).

We wish to advise you that, pursuant to 30 CFR 211.75, the Secretary has adopted Montana reclamation requirements as applicable to Federal coal leases in that State (FR 30175, June 13, 1977). On the same date, the Secretary and the Governor of Montana entered into an agreement whereby the State assumes responsibility for enforcement of coal surface mining reclamation requirements on Federal coal leases in the State.

I am sure that the Secretary will give careful consideration to environmental and all other relevant factors in rendering decisions on this and other such proposals. I am confident that Montana State agencies will act likewise.

Sincerely yours,

V.E. McKelvey

Director

Copy to Commissioner
Montana State Land Department

United States Department of the Interior
BUREAU OF INDIAN AFFAIRS
BILLINGS AREA OFFICE
316 NORTH 26TH ST
BILLINGS, MONTANA 59101

IN REPLY REFER TO:
Environmental Quality

JUL 8 1977

Mr. Michael Woods
Department of State Lands
Capitol Station
1625 11th Avenue
Helena, Montana 59601

Dear Mr. Woods:

This office has reviewed the draft environmental statement for the "Proposed Expansion of Westmoreland Resources Absaloka Mine Into Section 36, T. 1 N., R. 37 E", and wish to submit the following comments:

A. 1. Page 6, paragraph 3, states in part that "To date the Absaloka mine has been confined to this original 770 acres, pending approval of both the Bureau of Indian Affairs (1976) final EIS for lease tracts II and III and the U.S. Geological Survey final EIS (pending) for Westmoreland's 20-year mining plan." For clarification purposes it is to be noted that the BIA environmental statement for Tracts II and III was approved by the Secretary of the Interior on January 19, 1976; the USGS released the final environmental statement on the 20-year mining and reclamation plan on May 31, Secretarial approval is pending.

B. 2. Page 7. There is a discrepancy in the projected amounts of coal to be mined as reported by the BIA and USGS in their final environmental statements. Annual production in these two reports for 1977 is 6 million tons rather than 5 million tons annually. In 1988 projected annual tonnage is 18 million tons (this information is missing in the statement). In addition, it is perhaps erroneous to attribute projected annual production solely to the Absaloka mine. Westmoreland Resources is planning on extracting 2 million tons of coal annually from Tract II in 1981, which will be an operation separate and apart from the present Absaloka mine.

C. 3. Page 76, paragraph 3. The statement that "Non-Indians on the reservation fall under the jurisdiction of the County Sheriff" should be changed to read "Non-Indians on the reservation may be subject to the jurisdiction of the County Sheriff, the State of Montana, or federal authorities, depending upon the circumstances of the offense."

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

DSL RESPONSE TO LETTER

FROM

BILLINGS AREA OFFICE

BUREAU OF INDIAN AFFAIRS

A. The text has been changed to reflect the information contained in the comment.

B. The text of the EIS has been changed to reflect the information contained in the comment.

C. The text of the EIS has been changed to reflect the information contained in the comment.

D. 4. Page 106, Mitigating Measures. It would be appropriate to discuss the adoption of portions of Montana state law that govern reclamation of Federal coal leases disturbed by surface mining in Montana, and the cooperative agreement between the Department of the Interior and the State of Montana that governs the administration and enforcement of reclamation laws affecting federal coal leases in Montana. The adoption of portions of the Montana State Law and the cooperative agreement were published in the Federal Register on Monday, June 13, under the authority contained in 30 CFR, Part 211.

E. 5. Page 114, last paragraph. "Coal dust is transported...". Delete the word dust.

We appreciate the opportunity to have provided comments on this environmental statement.

Sincerely yours,

Area Director

D. The text of the EIS has been changed to reflect the information contained in the comment.

E. The text of the EIS has been changed to reflect the information contained in the comment.

OFFICE OF THE DIRECTOR

United States Department of the Interior
BUREAU OF MINES
2401 E STREET, NW.
WASHINGTON, D.C. 20241

July 27, 1977

In Reply Refer To:
EBM--MMSDA-AD-FO

Environmental Coordinator
Department of State Lands
Capitol Station
Helena, Montana 59601

Dear Sir:

We have reviewed the draft environmental impact statement prepared by your department on the proposed expansion of the Absaloka mine of Westmoreland Resources, Inc., into section 36, T. 1 N., R. 37 E. We offer the following specific comments on the statement:

A. Page 9, paragraph 1, sentences 1 and 3 and page 18, figure 3: The type of coal (subbituminous coal and lignite) available is not specified in this report. We suggest adding "subbituminous coalbeds" to the first sentence, and "minable resources of subbituminous coal and lignite" to the third sentence.

B. Page 19, line 8: Subbituminous coal and lignite should be specified for coal resources. The estimate of 44 million tons given for two coalbeds mentioned does not agree with 171 million tons of production forecast for the mine on page 7.

C. Pages 53-60: "Land use" (pages 53-56) and "Economics" (pages 56-60) should compare the economic impact of coal mining with other land use. Values are given for farming in table 16 (page 55), but no values are given for coal mining.

D. The difference in economic impact between land use for coal mining and agriculture is substantial based upon wealth added to the economy. According to the Bureau of Mines Mineral Industry Survey entitled "Coal--Bituminous and Lignite in 1975" (published February 1977), 22.1 million tons of subbituminous coal with minor amounts of lignite were produced in Montana. The average value was $5.06 per ton

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DSL RESPONSE TO LETTER

FROM

U.S.D.I. BUREAU OF MINES

WASHINGTON D.C.

(July 27, 1977)

A. Your suggestion has been incorporated into the text.

B. Your suggestion has been incorporated into the text.

C. Much of the information necessary to prepare a complete economic analysis is unavailable. The figures you cite give some indication of that impact as do the tax revenue figures found on page 125.

D. No comment required.

f.o.b. mine. Comparable figures for 1974 totaled 14.1 million tons
E. valued at $3.90 per ton. Using these average values, the value of coal mined from the Absaloka mine in 1975 is estimated at $20.1 million compared with $5.7 million in 1974. At these rates, the 48 acres mined in 1975 at the Absaloka mine produced $427,000 per acre, and the 32 acres mined in 1974 produced $178,000 per acre. Comparable figures for agriculture in Big Horn County in 1974 show that the 2.7 million acres used in agriculture produced $34.2 million, or $12.70 per acre, with the 250,931 acres of cropland producing $51 per acre.

We appreciate the opportunity to review this statement.

Sincerely yours,

Morgan

Acting Director

E. No comment required.

United States Department of the Interior
BUREAU OF OUTDOOR RECREATION
MID-CONTINENT REGION

MAILING ADDRESS
Post Office Box 25387
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION
603 Miller Court
Lakewood, Colorado
Telephone 234-2634

IN REPLY REFER TO
E30

JUL 21 1977

Mr. Brace Hayden
Environmental Coordinator
Department of State Lands
Capitol Station
Helena, Montana 59601

Dear Mr. Hayden:

This is in response to your request for our review and comments on the environmental impact statement for the expansion of the Westmoreland Absaloka Mine.

The expansion of coal mining activity at the proposed area will have no immediate effects on outdoor recreation resources; however, we believe further discussion concerning the effects of local population growth on recreation resources should be included. We note that mitigating measures have been proposed for reducing project-induced population pressures on essential social services (schools, housing). It would seem that increased pressure on recreation facilities should be similarly recognized and compensatory measures proposed.

The statement mentions that the Forestry Division of the Montana Department of Natural Resources prepared a preliminary environmental report for a timber sale which will be necessary if this permit for expanded mining is granted. This sale and its effects on native vegetation and wildlife is evidently then an ancillary part of the proposed action. The precise location and extent of this sale should be discussed in the context of project-induced vegetative disturbance.

Sincerely,

Robert J. Arkins

Robert J. Arkins
Assistant Regional Director
Land Use Coordination

DSL RESPONSE TO LETTER

FROM

U.S.D.I. BUREAU OF OUTDOOR RECREATION

MID-CONTINENT REGION

(July 21, 1977)

All of your comments have been incorporated into the text.

SURFACE MINING RESEARCH LIBRARY

BOX 5024

CHARLESTON, WEST VIRGINIA

July 25, 1977

Mr. Leo Berry Jr. Commissioner
Department of State Lands
Capitol Station
Helena, Montana 59601

Dear Mr. Berry:

I have submitted to your Environmental Coordinator the enclosed comments on the "Draft Environmental Impact Statement For The Proposed Expansion of Westmoreland Resources Inc. Absaloka Mine Into Section 36,T1N, R37E." Unfortunately, I did not receive a copy of this statement until too late for you to receive my comments by July 25, 1977.

I do believe my remarks, especially those on Chapter #7 are significant, and deserve careful consideration in looking at this issue overall. I trust you agree that public decisions, whatever they finally are, should be based on rational information. Chapter #7 surely does not contain accurate information and thus makes a rational decision on this leasing-mining issue hard, it seems to me.

I also would like to request, in the interest of a broad information base for your department, that the following persons receive copies of drafts of coal-related environmental impact statements:

Norman Kilpatrick, Director
Surface Mining Research Library
Box 5024
Charleston, West Virginia 25311

Cloyd McDowell, President
National Independent Coal Operators' Association
Box 230
Harlan, Kentucky 40831

Dewitt Harrold
Tazewell, Virginia 24651

O.V. Vande Linde
Vande Linde Associates
1117 Virginia Street East
Charleston, West Virginia 25301

Your consideration of these requests will be greatly appreciated.

Yours truly,

Norman Kilpatrick
Norman Kilpatrick, Director

COMMENTS ON CHAPTER #7 - DESCRIPTION OF ALTERNATIVE ACTIONS

It seems clear this section is based on a lack of understanding of coal mining. To the extent that such wording appears in other documents, it, too, should be stricken and replaced by honest and accurate statements about the alternatives to unrestricted development of Montana coal.

A. Section A - Denial of the Permit - The statement, "Low-sulfur coals from Illinois and Appalachian are used, almost exclusively, for metallurgical processing," is a lie! No one connected with the coal industry (and surely someone connected with the industry suggested this wording) believes Illinois has any significant amount of low (1% sulfur by weight for a 12,000 BTU coal) sulfur coal. Anyone knowledgeable of the coal industry is well aware that almost 1/2 of Appalachia's low sulfur coal is used for electric utility and industrial generation of steam or heat. This coal generally has a "coke button" or Free Swelling Index of 6 to 9. Coal with a "coke Button" of less than 6, even with a low sulfur content, has little or no market unless sold in the same market as that the Absaloka Mine coal is directed at, electric utilities.

B. Because of this gross misrepresentation the obvious economic impact of a phase out of the Absaloka Mine is omitted. That is the increase in jobs in Appalachian that would result from phasing out movement of this coal into Illinois and Indiana. Since this coal's delivered price is slightly more (on a B.T.U. basis) than low sulfur Appalachian coal the American economy would doublely benefit from such action. Additionally, termination of the movement of this coal east of the Mississippi is in the national interest because it would save some 80,000 gallons of fuel oil per million tons compared to delivery of low sulfur Appalachian coal to Illinois River power plants which receive West Virginia and Eastern Kentucky coal by fuel efficient barge movement. Indiana plants inland from the Ohio River represent a year's savings of 40,000 gallons of fuel oil per million tons of coal, comparing delivery of Appalachian low sulfur coal to montana coal. Appalachian railroads such as the Chessy System and the Norfolk and Western Railroad have a surplus of rail cars and, together with numerous barge lines serving Charleston, West Virginia; Huntington, West Virginia; Big Sandy River, Kentucky; and Ghent, Kentucky stand ready and able to move massive amounts of low sulfur coal from the huge fields of coal in Virginia, Eastern Kentucky, and West Virginia.

DSL RESPONSE TO LETTER

FROM

SURFACE MINING RESEARCH LIBRARY

A. The text has been changed to reflect that low-sulfur coals from Illinois and Appalachia are used for metallurgical processing, industrial and utility purposes.

B. In regards to your concern over eastern vs. western coal production, refer to the Billings Area BIA Office's CROW CEDED AREA COAL LEASE TRACTS II AND III, WESTMORELAND RESOURCES, (FES 76-64), Chapter VIII pages 12-14.

It is not within the purview of this EIS to assess the possible effects on Appalachian jobs caused by the mining of Section 36 coal. To help assure job protection, among other things, the Carter Administration is encouraging the use of mid-western and Appalachian coal east of the Mississippi and use of western coal west of the Mississippi. The federal coal leasing policy is the key tool for shaping such development. This can be accomplished by controlling federal lease levels so that expected gaps created by federal production goals which are not filled by one region's supply and demand can be filled by the other region's. The anticipated impact on the eastern employment from the mining of Section 36 is negligible.

The economic impact of some restraint on Montana coal development was well stated some years ago when the "Final Environmental Impact Statement-Eastern Powder River Coal Basin of Wyoming" was prepared. Page 1-805A of this document stated, "The coal industry and the related economy of Appalachia may undergo a boom if it must supply the low-sulfur coal in lieu of production from the powder River Basin." They knew Powder River coal takes away Appalachian jobs, yet in 1977 the Montana Department of State Lands is not aware of this fact. Why?

Additionally, the "need" for this coal east of the Mississippi, which mainly serves the interests of certain coal buyers, certain utility stockholders, certain coal producers, but not eastern consumers, are surely numbered.

Already, a major customer for this mine's coal (Central Illinois Light) is phasing in low sulfur Appalachian coal. As a coal consultant for the Environmental Protection Agency I have met with Central Illinois Light officials and learned that use of this mine's coal has caused a loss of 15% to 20% of the generating capacity of the Edwards and Wallace plants. The loss of electrical load due to use of high moisture (over 15% water), low B.T.U. (less than 10,500 B.T.U.'s per pound) coal has been noted by American Electric Power (Kammer Plant), Tennessee Valley Authority (Johnsonville Plant), Commonwealth Edison and Detroit Edison, at times. This causes either a fuel clause cost increase due to power purchases from other systems, and/or a rate base increases due to burning unit modifications needed and greater operating costs. Low sulfur Appalachian coal will have a 4% to 10% water content, and a 11,500 to 15,000 B.T.U. content, which is a range virtually all Eastern utility power plants can accomodate easily.

Additionally, consumer and Eastern coal pressures are ending current movements of Western coal into Eastern states. Montana coal movements into West Virginia were stopped in 1975 when that state took away American Electric Power's automatic fuel adjustment clause. This spring action by the Ohio attorney General resulted in the end of Western coal movement into Ohio, it seems. Action against T.V.A. by the State of Kentucky and against the automatic fuel clause by the Pennsylvania Public Service Commission make Western coal's future in those states very dim. National legislation attacking automatic fuel clauses and challenging inter-regional coal movement may well pass this year, further threating uneconomic movement of Western coal. (Surely no one thinks utilities importing Western coal are doing so to benefit their consumers in states like Illinois, Indiana, Michigan, New York, Kentucky, Ohio and West Virginia.)

It also should be pointed out that during the past 12 months Georgia Power, Tampa Electric, Central Illinois Light, Dayton power and Light, Detroit Edison and American Electric Power (Appalachian Power) have moved to sign contracts for Appalachian low sulfur coal. Surely, if it were not here, as stated in this "Draft Environmental Impact Statement," it could not be contracted for!

I enclosed reports from Federal Power Commission #423's to support my statement that electric utilities do purchase low sulfur Appalachian coal.

C. Subsidence does not have to take place after deep mining is completed, if modern longwall or "retreat mining" techniques are utilized. (See enclosed) Even, uniform, immediate subsidence can and does take place in such a situation, creating minimal environmental disturbances. It is totally unfair to use a 44% recovery factor for old deep mining, when modern methods can remove uo to 80% of the underground coal. It costs more to deep mine coal and that is the major reason for opposing use of such modern mining technology.

D. Modern auger mining in Appalachia can remove 35% to 50% of a particular block of coal. No justification for the 10% recovery factor cited is given. It should be, if it is not a figment of some unqualified person's imagination.

E. Hanna, Wyoming, is the site of a major in-situ mining experiment. Failure to discuss this major effort suggests the writer does not understand this technology. Magnetohydrodynamics should be mentioned. Work at the University of Tennessee Space Institute is far ahead of any MHD work in Montana. I have seen it generate electricity using coal and American Electric Power is interested in bringing it to commercial use, I am told. Some discussion of this technology would be most helpful, and give some evidence the drafter knows what he or she is talking about.

F. The claim on page #128 that, "the only long-term unknown is compaction of spoils," concerning reclamation is absurd. Underground water supplies, from my personal observations in Montana, last May, are the major problem facing surface mine reclamation in the Powder River Basin. The best the company staff could say was that they were concerned and would do their best, but to say this is not a long-term unknown, as the draft does, is not reasonable. Nor, from what I can see, is it reasonable to suggest permanent revegetation of mined lands, which must stand 16 year and 60 year rainfall cycles, can be assumed to be solved. Appalachian reclamation (in Ohio, Pennsylvania and West Virginia) has 30 years of experience to draw on. Thus we know we can control our surface mining problems. No such experience exists in Montana with areas like this Westmoreland mine.

Montana may well desire unlimited coal growth. But surely public decisions on this issue should be based on honest facts and statements of issues, not lies about Appalachian coal or wishful thinking about reclamation results. Finally, if the rest of this draft is as inaccurate as this chapter, the entire document must be reworded by competent persons.

C. The EIS only states that subsidence often occurs after mining ceases and not that it always occurs. The 44% recovery factor cited was only for the North Data example listed. It is recognized that modern methods may produce a larger percentage recovery.

D. The reference to a 10% recovery factor under auger mining has been deleted from the text. To reflect the variability of recovery rates, the text has been changed to reflect that auger mining would recover a lesser percentage of the coal resource than under the proposed strip mining operation.

E. The EIS reference to in situ pertains only to alternative methods of removal of the coal resource. Magnetohydrodynamics was not discussed as it is an energy production process alternative and not a mining method alternative.

F. The text of the final EIS has been changed to delete the statement that compaction of soils is the only long-term unknown in strip mining.

STATE OF MONTANA

DEPARTMENT OF STATE LANDS

MAILING ADDRESS: CAPITOL STATION
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STATE BOARD OF
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AUDITOR

LEO BERRY JR
COMMISSIONER

SCHOOL LANDS

MINING

September 8, 1977

Norman Kilpatrick, Director
Surface Mining Research Library
Box 5024
Charleston, WV 25311

Dear Mr. Kilpatrick:

Thank you for your comments on the draft EIS for the proposed expansion of Westmoreland's Absaloka mine into Section 36, T.1N., R.37E.

Recently Westmoreland received U.S.G.S. approval of their 20 year mining plan for the Tract III area. Because of such approval Westmoreland would not begin mining in Section 36 in the immediate future. Furthermore, the Department is still studying unresolved questions with regards to the hydrology in Section 36.

In accordance with the Department's Montana Environmental Policy Act rules, a final EIS will be distributed for public and agency review no later than 30 days prior to issuing a decision on Westmoreland's Section 36 permit application. The distribution for the final EIS on Westmoreland's Section 36 EIS is now tentatively set for November 15, 1977.

Many thanks again for your comments. They will be carefully considered in the preparation of the final EIS.

Sincerely,

Brace Hayden

Brace Hayden, Administrator
Reclamation Division

sm

c: Leo Berry, Jr., Commissioner
Dick Juntunen

NORTHERN PLAINS RESOURCE COUNCIL

Main Office
419 Stapleton Bldg
Billings Mt 59101
(406) 248-1154

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Glendive Mt 59330
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August 10, 1977

Commissioner Leo Berry
Department of State Lands
Capitol Station
Helena, MT 59601

Dear Commissioner:

Recently, I received a copy of Mr. Norman Kilpatrick's comments concerning the Draft Environmental Impact Statement for Westmoreland Resources proposed expansion into Section 36, T1N, R37E. His comments bring to light a great deal of information to which people in Montana rarely have access.

Our organization has had to rely almost exclusively on sources outside the state to provide us with information concerning some of the broader economic implications of strip mining in Montana. It is extremely helpful to have comments from a reliable source such as the Surface Mining Research Library concerning the eastern and midwestern coal industry. As far as I know, there is no comparable organization in the state that can provide this sort of data with the same detail and accuracy.

Mr. Kilpatrick's comments also point out the superficial way in which the difficult and complex question of eastern coal as an alternative to western coal is usually considered. His information fills a gaping hole left in the draft Environmental Statement by its authors and is a critical piece to consider before making a sound decision on Westmoreland's proposed mining plan.

We request that you extend the comment period to allow inclusion of Mr. Kilpatrick's comments and that the points he raises concerning the availability of eastern low sulfur coal be addressed in the Final Environmental Impact Statement.

Sincerely,

Sarah Ignatius
Sarah Ignatius
Research Coordinator

cc: Brace Hayden

STATE OF MONTANA

DEPARTMENT OF STATE LANDS

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LEO BERRY, JR.
COMMISSIONER

SCHOOL LANDS

MINING

RECLAMATION

August 17, 1977

Sarah Ignatius
Research Coordinator
Northern Plains Resource Council
419 Stapleton Bldg.
Billings, MT 59101

Dear Ms. Ignatius:

Thank you for your letter of August 10, 1977.

Mr. Kilpatrick's comments concerning the Draft Environmental Impact Statement for Westmoreland Resources proposed expansion will be considered in preparing the final impact statement.

Sincerely,

Leo Berry, Jr., Commissioner
Department of State Lands

sm

c: Brace Hayden

FRIENDS OF THE EARTH INC

P. O. Box 882
Billings, MT 59103
July 22, 1977

Environmental Coordinator
Department of State Lands
Capitol Station
Helena, MT 59601

Dear Mr. Hayden:

The following comments and appendices are submitted by Friends of the Earth on the "Draft Environmental Impact Statement for the Proposed Expansion of Westmoreland Resources Inc. Absaloka Mine into Section 36, T1N, R37E." Numerals to the left indicate pages within the DEIS.

1. The Final should be amended throughout to show five-year permits.
A To what extent has the Crow Tribe challenged state coal ownership within the Ceded Area? What future challenge, if any, is expected? Under what authorities does the state claim coal ownership in the Ceded Area?

4. USGS FES 77-17 has been circulated and further comments have been submitted by Montana state agencies and citizens. DSL failed to comment on the USGS EIS, although the comment deadline was extended to July 15, 1977. Since USGS had received a copy of the instant state DEIS long before the July 15 deadline, it should be reasonable to assume that, in lieu of more specific comments, this DEIS constitutes the contribution of DSL to the USGS EIS process. B

On December 24, 1975, F.O.E. requested a public hearing on the proposed expansion through the November, 1975, PER. This request was denied (see Gov. Judge letter, Appendix I, Jan. 7, 1976), and a state permit to mine outside the are covered by the original BIA EIS (1974) was issued without compliance with MEPA, since the original state EIS relied heavily upon the BIA EIS and, therefore, the PER was promoted on an insufficient data base. This is evidenced in failure to account for spring in section 25 DCBC and groundwater flows into the coulee within the Section 9 (RCM 50-1042) area immediately to the west, and for wells 274, 275 and 276, as well as potential impacts upon groundwater flows within the proposed lower East Fork Sarpy Basin reserve of proposed mining outside the original 5-year plan within sections 24 and 25, as alluded to in drawdown information provided within DSL DEIS, Appendix G, Analysis of Groundwater Effects, Dames & Moore, p. 2. This would appear to be a violation of RCM 50-1038(5), 50-1039(2)(j), (3)(c) and (3)(f), and perhaps 50-1042, as well as MEPA. Furthermore, it is entirely inconsistent with the statement of Governor Judge before the old U.S. Senate Interior Subcommittee on Minerals, Materials and Fuels, May 8, 1975:

> "What I am saying is, before the Federal Government proceeds with leasing, we would like to see those kinds of studies made in terms of whether or not the land can really be reclaimed. I believe there are lands that cannot be reclaimed as well as possibly lands that would have a better possibility of success with reclamation and in terms of all the environmental economic problems that a certain area might have. The aquifers, the salinity problems, all of these questions must be addressed before the Federal Government goes ahead with a policy of just rapid leasing and strip mine - coal companies come in and start mining. I think we have to know a great deal about an area that is going to be mined."

F.O.E. suggests that the inconsistency between the Governor's statement above and his letter of Jan. 7, 1976 (App. I) can be traced to present Lt. Governor Ted

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DSL RESPONSE TO LETTER

FROM

FRIENDS OF THE EARTH

(July 22, 1977)

A. The information contained in the EIS on pages 1 and 7 as to terms of permits is correct as stated. For clarification purposes, the text has been changed to reflect that the permit application for Westmoreland Resources now pending before DSL will, if approved and issued, be for a term of five years as provided by Section 50-1039 of the Reclamation Act.

At the present time, the Crow Indian Tribe has not formally brought an action or cause into a court of competent jurisdiction. What actions the Tribe may take in the future are only conjecture and not within the purview of this EIS.

Title to Sections 16 and 36 in the ceded area, including Section 36, T.1N., R.37E., M.P.M., passed to the State of Montana under the provisions of the Act of June 21, 1934 (48 Stat - 1105) as granted by the Act of February 22, 1889 and July 26, 1927 (44 Stat - 1026). Title to the subject Section 36 vested in the State of Montana under the Act of April 27, 1904 (33 Stat - 352) upon acceptance of the plat of survey by the General Land Office (now the Bureau of Land Management). The plat of survey of the subject Section 36 was accepted May 23, 1906. If challenge were made to the state's title, the listed chain of title could not be considered exclusive.

Schwinden (see letter from Lt. Gov. Schwinden, Mar. 9, 1973, with attached newspaper clip - App. J). Equal responsibilities should fall to state and fed. In further consideration of earlier state EIS and PERs, was any state approval required for the transfer of the instant lease from Consolidation to Westmoreland? Should the section 36 DEIS have been triggered at that point? Surely any assignment or contract for surface rights to Westmoreland should have been preceded by the DEIS.

C 9. USGS FES 77-17, Figure 9, page 32, is obviously not consistent with DSL DEIS, Figure 2, nor is USGS Figure 5, p. 18, as to proposed mining of the south half of section 36.

Title to the subject Section 36 in the State of Montana is evidenced by US patent number 1128788 issued April 21, 1950. Both the surface rights and the subsurface mineral estate, including coal, are presently owned by the State of Montana.

B. The USGS EIS was a broader evaluation of environmental areas on the entire Tract III area, including the subject Section 36. OSL had determined that the expansion of the Absaloka Mine into Section 36 was a major action significantly affecting the quality of the human environment and thus would require a site specific EIS under the provisions of the Montana Environmental Policy Act (MEPA). Throughout the preparation of both the draft and the final EIS by USGS, the OSL provided inputs and assisted in the coordination of the planning for the statement (refer to p. 408 of the Final EIS 77-17).

No comment is required on the remainder of this comment item as it pertains to opinions on policy interpretations not within the purview of this EIS and on earlier matters of historical interest only.

OSL approved the assignment of State of Montana Coal Lease C-1047-70 from Consolidated Coal Company to Westmoreland Resources July 13, 1973. Assignments of coal leases are not activities or functions that normally require the preparation of an EIS under MEPA and the OSL rules thereunder because such evaluation would be premature.

C. Figure 9, page 32, of the USGS FES 77-17 is a generalized version of post-mining topography for the entire proposed mine area. This figure was based on Westmoreland 1975 data. Figure 2, p. 10 of the State Draft EIS portrays the proposed mining plan for Section 36 only and is based on 1977 data. Figure 5, page 18 of the USGS FES 77-17, is also based on 1975 data.

10. Does Figure 2 represent the five-year mining plan now required?

31. What remedial steps will be taken to attain compliance with state air quality standards? (See also comments below)

35. Some discussion of stock ponds such as that fed by spring 237, and their potential replacement, should appear.
Much more than two square miles of Tract III drain to the East Fork, and much more than six square miles of Tracts II and III drain to Sarpy Creek. (See USGS FES 77-17, Fig. 7, p. 23)

39. Figure 6. Why do these maps usually show the Westmoreland-owned surface outside the Ceded Area purchased from Reddings but not that purchased from Cox?
Fig. 6 is in violation of R&R 26-2.10(10)-S10310(2)(e), in that at least 8 springs are missing, including 36 ACDC, which served as the domestic water supply for the Roberts family for many years. Others missing are: 19 ACCB, 19 DBCD, 25 DCBC, 30 BDAD, 31 CCDB, 33 ACCC and 35 BDAC.

38. Does DSL dispute springs 237, 238 sources as listed in USGS FES, App. C, Tables 27 and 28?
DSL acknowledges subirrigated conditions denied by USGS FES, p. 453, first response, (#39). (See Also DSL p. 95)
Possible effects on groundwater of structural trough acknowledged. What possible effects of mining in and adjacent to that trough on adjacent groundwater flows?

D. Yes.

E. Westmoreland Resources will be required to comply with all applicable regulations on air quality of both the Federal government (EPA, MESA, OHSA) and the State of Montana. The Air Quality Bureau of the Montana Department of Health and Environmental Sciences is the agency responsible for regulation and enforcement of air quality standards.

F. This is discussed in the text. See IV (B)(4)(a).

G. The spring inventory conducted during the baseline studies revealed most of the springs being used at this time. If you have additional information, the Department would be pleased to verify the location and quality of additional springs that have been located.

H. As additional knowledge has been gained concerning the geology of Tract III the Department has attempted to revise earlier information. At this time our best estimate is that the springs corespond to the base of a silt-sand section which lies on shaly strata above the stray one coal seam (Nick Tudor, personal communication). Water at Spring 238 is issuing from alluvium in the coulee that is underlain by a shale zone, however the ultimate source of the springs is from a point up the coulee where ground water is discharged from the silt sand strata described above. The subirrigated conditions described by DSL are not subirrigated dryland cropland as described in the comment to the USGS but it is probable that subirrigation is occurring to the native vegetation in the coulee bottoms. Subirrigation in this context refers to the additional moisture moving into and through the valley fill that is available for plant use.

I 42. Figure 8 is in violation of R&R as is Fig. 6 in comment 39 above. Three working wells (30 DDBC, 27 BBAD and 28 BDBC) are omitted, as well as six abandoned wells (2 ABAC, 19 BCCC, 19 DCDB, 30 CABA, 30 DCBB, and 32 CBDC) which further indicate available grounwater in aquifers above the Sub-Robinson unit as these are relatively old and shallow wells. Wells 131 and 252 are misplaced (see descriptions); check 325.

J 41. Remarks about wells should reflect the reality of Tract III and the proposed 20-year mining plan (see attached appendix G, well table prepared by F.O.E.). Further, there may have been e well on the Bill Johnson place, now on Crum's east of section 36.
No potentiometric maps of the Rosebud-McKay overburden (i.e. Stray 1,overburden, Stray 1 seam, and Stray 1 - Rosebud interburden) are provided, yet this aquifer has the highest transmissivity and will produce the greatest pit flows (see DSL App. G, Dames and Moore). This appears to be a violation. Where is recharge occurring to the constituent strata of the Rosebud-McKay overburden? Further, there is no potentiometric map of the McKay-Robinson interburden, including Stray 2 seam.

K 47. How does Figure 9B indicate that the interburden is saturated? Is the Robinson Coal an unconfined aquifer? What affect will mining have on the potentiometric surfaces and, therefore, on the SE - NW trending axis of present groundwater divide?

L 50. Section 36's unique productivity, .38 aum/acre, plus highly diversified vegetation, including "...sizeable areas of dense timber, shrub communities and steep, relatively barren slopes...," indicate characteristics defensible under RCM 50-1042 and 50-1045. F.O.E. expects the permit to mine section 36 to be denied, but we are prepared to litigate. Further, section 36 should be nominated under at least the "additional farmland of local (if not state-wide) importance" for Prime and Unique Farmlands criteria, U.S. Dept. of Agriculture, Oct. 15, 1975, attached as app. E.

Mining adjacent to the structural feature should have little if any impact on the springs in Section 36. Mining in the trough is discussed in the text under III (A)(4)(b)(1).

I. The well inventory conducted during the baseline studies revealed primarily those wells in current use. The Department would be happy to verify the location and quality of water from additional wells that have been located.

J. Refer to comments under appendix G.

A potentiometric map of the Rosebud-McKay overburden has been prepared (Refer to II (A)(6)(b)). Recharge to the overburden is occurring vertically from precipitation over the areal extent of the strata and laterally from the continuous unit to the southeast.

The Rosebud-McKay-Robinson interburden is composed of a highly variable lithology consisting of sandstone, siltstone and shale. Due to the discontinuous nature of the strata and the apparent lack of depending on water from this zone the Department feels the interburden is not a significant aquifer.

K. Figure 9B does not indicate the interburden is saturated since the Robinson coal is a confined aquifer. A change has been made in the text.

Please refer to III (A)(4)(b)(1) in the text.

L. Productivity and diversified vegetation per se are not sole criteria unless the lands exhibit special, exceptional, critical or unique characteristics in addition. Consideration of the criteria set forth in Section 50-1042 will be given, and evaluations will be made by DSL prior to approval of any permit in Section 36.

What is the status of the Dept. of Fish and Game's bird study for this area?	M. The study by the Department of Fish and Game pertains to a sharptail grouse dancing ground north of the existing mine area and does not involve Section 36.
51. Between associated disturbance and water impoundment (Fig. 2), how much wildlife habitat diversity would be retained? It looks to be negligible.	N. There should be little change in the amount of wildlife habitat diversity around the area of associated disturbance. There would be a loss of habitat diversity at the water impoundment until the wildlife habitat was returned by reclamation practices. In addition, an area in the SW¼, Section 36, has been excluded from the disturbed area, primarily for the protection of wildlife habitat.
62. Has the Crow Tribe changed its stated position, Dec., 1976, regarding Westmoreland?	O. Refer to pp. 413-416 of the USGS FES 77-17. There is no evidence in the FES that the Crow Tribe submitted any formal comments on the FES.
80. There is no mention of the Indian graves on the hill in the southeast quarter of section 3, T1N R37E within Tract III, which former surface owner Madge John says were to be set aside and protected as told to her by an archeologist in the employ of Westmoreland.	P. The matters mentioned pertain to lands other than Section 36, T1N, R37E, M.P.M., which is the subject of this EIS, and are therefore beyond the purview of this EIS.
81. Historical section should discuss the turn-of-the-century Howell Wagon Road from East Fork Sarpy to Crow Agency, still visible on section 36. It appears on the following early plats: #2611, 2720, 2721, 3349, 3350, and 4269. Has the possibility of protecting this road been examined? Furthermore, springs in the East Fork Sarpy Basin were and still are a unique fall season source of water and were sought out during the early cattle drives before homesteading and after.	Q. In reference to the wagon road, see AO.
83. Reclaimed land cannot provide for present diversity and productivity.	R. No comment required.
85. Non-compliance as indicated for p. 31 comment should be addressed.	S. Some comments given above under E apply to this comment.
86. Soils impacts should be analyzed in terms of RCM 50-1042 and 50-1045.	T. Some of your concern has been addressed in IV (B) (3). By separate salvage and replacement of surface soils, the organic materials, nutrients, and plant propagules in surface soils will be preserved to some extent in a concentrated form.

88. Missing spring 36 ACDC was the Roberts' homestead domestic source for many years. How will water of quality equal to these springs be provided? Does Section 130.17 (e)(2), EPA regulations under FWPCA apply where it refers to "...waters of... ecological significance..."? Obviously spring 237 is presently a good source of drinking water in conjunction with recreational uses on section 36, also under the above regs.

U. Water of equal quality cannot be replaced. It is the opinion of the Department of State Lands that water should be provided in like quality to sustain similar land uses. The quality of an alternate source of water must therefore, be adequate for stock watering purposes. All wells determined to be sub-Robinson (Dames and Moore Baseline Studies Appendix E) were examined for constituents that would make the water unsuitable for stock use. Total dissolved solids appeared moderately high, however only three samples (out of 32 total samples) contained T.O.S. levels over 3,000 mg/l which is recommended as satisfactory for livestock under any circumstances (Water Quality Criteria 1972). None of the T.O.S. values exceeded 3,000 to 5,000 mg/l which is discussed as satisfactory for livestock but may cause temporary diarrhea.

Sulfate levels appeared moderately high in the sub-Robinson water. Recommended limitations for sulfates in the literature is vaque. After checking water usage in the Sarpy Creek area it was determined that water from other sources containing higher levels of sulfate was being used for both stock and domestic purposes.

In summary the sub-Robinson waters are not ideal for stock use, as described above, but are in general suitable for such use.

The department agrees that waters from springs 237 and 238 have ecological significance with regard to the moisture being supplied to vegetation in the coulee bottoms. The ultimate question is whether the vegetative and animal dependence on the moisture constitutes "exceptional . . . ecological significance" specified under section 130.17(e)(2), of the E.P.A. regulations. This terminology parallels Section 50-1042 of the Strip and Underground Mine Reclamation Act under which such values are being weighted.

V 89. Impoundments will destroy habitat diversity in unmined areas, reducing the value, e.g., of unmined southwest quarter land (see p. 95).	V. Impoundments may reduce habitat diversity to some extent but will not destroy it.
91. The low quality grounwater arguement is contradicted by high quality groundwater in springs, e.g. 237.	W. The higher quality spring water derives from near surface aquifers. The residence time in such aquifers is of comparitively short duration and is dependent upon local recharge.
92. This section is not completely compatible with DSL appendix G.	X. The presentation in Appendix C is based upon conservative data estimates and reflects the most possible care. The statements on page 92 still stand.
93. Since it is not possible to accurately predict the area that would experience declines in water levels, springs in the proposed reserve may be endangered. Dames and Moore appendix G suggest there is danger. Therefore, mining of sections 24, 25 and 36 should not procede, in any case, until potential impacts can be accounted for. This is especially important along the structural trough. Monitoring the cone of depression would not save the critical and unique springs of the wet coulees immediately east-northeast of the present mine if groundwater flows are disrupted.	Y. Refer to changes to text of Section III (A)(4)(b)(1).
93-94. Reference to Westmoreland data around the existing mine contradicts the stated inapplicability appearing on p. 92.	Z. The section on page 92 is intended merely to point out that the nature of aquifer material in Section 36 is not fully comparable to aquifer material around the existing mine, and that extra problem of raw data relative to mining thus far, to Section 36 must therefore be done with caution.
AA 96. To what extent are hydrologists conceding the impact of blasting on wells, either at Sarpy or elsewhere?	AA. Hydrologists concede that under certain conditions blasting may affect wells and research is going forward on this subject.
AB 97. How will this groundwater flow alteration affect the springs adjacent? Will not groundwater tend to outcrop or subcrop far below present springs, or near the base of the Robinson Coal rather than the Rosebud-McKay as stated, and closer to Sarpy Creek and the East Fork? What will be the impacts of greater groundwater mineralization, including potential for saline seeps? Presently the area is devoid of saline seeps.	AB. The text has been corrected to read Robinson rather than Rosebud-McKay. The appearance of saline seeps generally occur after an increase in the vertical flow of groundwater causes the upward movement of dissolved salts. Saline seeps may also occur at springs. However, if the throughflow is significantly greater than the rate of evaporation the potential for accumulation of salts is lessened.

AC 99. Which plant species may be eliminated? What percentage of present species and what volume of present vegetation do they represent, i.e., those that may be eliminated? What plants are now present? There needs to be a list such as that in USGS FES, p. D-42.
Further discussion of productivity as to RCM 50-1042 and 1045 is in order.

AD 100. Much of the north half of section 36 has been farmed, as state records should show. Areas of alleged overgrazing that would not be affected by mining should be identified. (All recovery of farmed ground to native range has been natural. Farming is not near the disturbance of strip mining.)
What remedial action can be taken to prevent plant damage from dust?

AE 101. Section 36 should not serve as a sacrifice area for reclamation experimentation. The listing of possible and dreamed wildlife futures does not satisfy the analytic need for a reasonable projection. As well, the entire wildlife community must be considered. (See comments on USGS by Matson, attached as app. F.)

AF 102. If considerably more information is needed, how can a reasonable decision be made under RCM 50-1042 and 1045? It is important to weigh heavily the fact that "successful reclamation...has not been demonstrated..." (Also, see p. 89 - "...do not provide adequate information...")

AG 103. Use of the term "temporary" should be explained. Also, some discussion of observed avian mortality from impact with the dragline should appear here. Further, DSL should consider preliminary findings of Dale Reed, Colorado Division of Wildlife, Glenwood Springs, CO: "Effects of Harrasement on Mule Deer."

AH 104. DSL should consider all implications of apparent pending or initiated construction of 60-unit trailer park near Spring Creek Bar at Sarpy Creek by Jim Romine. Has the Dept. of Health been involved with this project as yet?

AC. It is impossible to identify plant species that will be eliminated. On pages 99 and 100 the Department identified the communities it feels will be difficult to re-establish, based on the ecology of the plants involved and present reclamation technology and success. It may be possible to re-establish these communities for a single generation but regeneration is subject to doubt. Other species will likely be affected and/or eliminated, but they cannot be specifically identified. Reclamation is still in its infancy; only through time will we be able to document the species which cannot survive on a reclaimed surface. A species list has been added (see appendix).

AD. See Westmoreland's response. Spraying plants with water helps reduce the possibility of dust damage as does spraying haul roads and other dust reduction techniques. Climate factors such as rain and wind also mitigate possible damage.

AE. Wildlife futures depend upon revegetation success which is itself - as is frequently noted - not yet proven, as such, wildlife futures are not yet proven.

AF. The information needed section in the text refers to general requirements of individual species - not to what is available in Section 36 as such, the information requirement applies to any and all mine sites in the Northern Great Plains.

AG. comment is noted.

AH. Current information indicates construction of a 10-unit maximum trailer park at the location cited. The Department of Health and

1 105. Blasting shocks should be reduced to two-tenths inch per second as recommended by Eugene Carden, Ph.D. (see app. D, attached), and apparently agreed to by Peabody Coal Co. at its mine near Sparta, Illinois. DSL should acquire a copy of Dr. Carden's testimony in blasting damage suits from Terry Noffsinger, Esq., P. O. Box 3155, Evansville, Indiana 47731, or from myself at cost of reproduction (approx. $14.50). If not already acquired, DSL should acquire a copy of "Strip Mine Blasting," published by Center for Science in the Public Interest, 1757 S St., NW, Wash. 20009.

J What royalty does the state expect from section 36 coal? If 17½¢/ton, can that be justified as "full market value"? Does severance tax also apply?

Environmental Sciences may be involved if the development must comply with the subdivision regulations as to water supply, sewage disposal and solid waste disposal plans.

AI. The mining industry has assumed that no damage to structures occurs when ground movement is 2 inches/second or less. Dr. Carden has pointed out that this is not true in all cases. It may however, be true in most cases. Dr. Carden's data is derived from observations in the East and Midwest, where the density of cultural features is greater and where methods of building construction may be different from those employed in farm structures of rural Montana. Evaluation of allowed ground movement can be made on an individual discretionary basis.

AJ. The terms of State of Montana Coal Lease C-1047-70 provide that the lessee shall pay a royalty at a rate of 17½¢ a ton on subbituminous coal. At the date of execution of the lease (June 3, 1970), the royalty rate was considered "fair market value." The royalty rate is adjustable upon the expiration of the intitial 20-year period if the lessee desires to extend or renew the lease. In recognition of the rapidly rising price of coal the Board of Land Commissioners suspended leasing and the royalty rate was changed to 10% of the f.o.b. mine price in 1975. The severance tax, as provided by the Coal Severance Tax (Chapter 13 of Title 84, R.C.M. 1947), does apply to the subject lease.

AK	106-113. Why is the Enabling Act omitted? Does not DSL take the position that RCM 50-1042 cannot apply on state land? How will the new federal strip mine law affect application of the Enabling Act under RCM 50-1042?	AK. The Enabling Act was omitted from this section for the reason that it is not considered a significant state law in terms of providing for mitigation measures. The department has based its decisions on the assumption that Section 50-1042 of the Reclamation Act applies to Section 36. The federal Surface Mining Control and Reclamation Act of 1977 does not supersede the provisions of Section 50-1042 of the Reclamation Act nor does it modify the application of the Enabling Act.
AL	106. RCM 50-1042 and 1045 should be printed in theri entirety.	AL. The information contained in the EIS is a summary only of the Reclamation Act. Printing of entire sections or the entire act would make the EIS unduly voluminous.
AM	107. When does the 240 days commence or expire? Does DSL accept the section 36 application as complete although "...considerably more information is needed..."(p. 102), and, e.g., certain springs and wells have been omitted? (See also comment #102, above.)	AM. The 240-day period commences upon the date the application is complete as determined by the OSL. The formal determination of a completeness date has not been made by OSL.
AN	109. 3. What is the implication of lowered productivity of the highest quality school section under prohibition of such impairment? (RCM 81-103)	AN. The impairment of productivity term also includes consideration of the relative values of the various resources, including coal. Consideration and evaluation of all values will be given by OSL prior to any approval of the subject mining permit particularly those items described in Section 50-1042 and 50-1045 of the Reclamation Act.
AO	111. 7. Has the Howell Wagon Road been considered under the state Antiquities Act? Has the impact of blasting on medicine rocks as observed by Crow Tribal Vice-Secretary Ellis "Rabbit" Know's Gun (see USGS FES comments, p. 5, item 28, attached) been considered? Has reduction of blasting to two-tenths i.p.s. been considered? F.O.E. requests implementation of two-tenths i.p.s. standard state-wide.	AO. The Howell Wagon Road has not been considered under the Antiquities Act as it does not appear to be significant in nature. If more information becomes available, action may then be taken. OSL has confirmed the same conclusions as Westmoreland regarding the "medicine rocks". Modification of blasting requirements will be considered in light of the federal strip mine act.

AP	113.	The cited FES ignores the exchange of interests in coal proposed by the Crow Tribal Vice-Secretary and F.O.E. under Section 206, Federal Land Policy and Management Act of 1976. What effect would the President's signing of the pending strip mining legislation have upon the proposed mining plan?	AP. The exchange of coal interests subject was adequately addressed in both the BIA EIS (FES 76-64) and the USGS EIS (FES 77-17). Page 399 of FES 77-17 outlines the status of such action. DSL would also not be involved in such action, as it is the owner of both the surface and subsurface mineral estate of the subject Section 36. The proposed mining plan will be required to meet the applicable requirements of federal Surface Mining Control Act of 1977 and the regulations adopted pursuant thereto.
AQ	114. 115.	What remedial action is available against continuing air quality violations? Since "It is not likely that much can be done...", at what point does air pollution become a limiting factor to increasing strip mining activity?	AQ. Response is the same as given above under response E.
		Some consideration should be given to sod block topsoil salvage, both for its own sake and for the increase in non-skilled jobs it would provide in an area where many non-skilled are unemployed.	Sod-block topsoil salvage has been done at Colstrip and seems to be effective. If Westmoreland wishes to employ this technique it is perfectly free to do so. The DSL feels however, that it cannot justify requiring sod-block topsoil salvage.
AR	116.	What would be the comparative quality and cost of maintainance between existing springs and proposed Sub-Robinson wells? Who would bear the cost of maintainance? Spring 237 has flowed undiminished and uninterrupted for over 50 years, as Mrs. Vella Redding can testify, at no cost except insignificant occasional cleaning. A 50-year projection of comparative future costs and inconvenience should be provided in the FEIS. What potential for damage to the Sub-Robinson aquifer, as posed by Stephenson (appendix A, attached), has been considered in assuming future water supply?	AR. An estimate of maintaining a well to the sub-Robinson would be extremely speculative. These costs would have to be absorbed by the surface lessee unless other arrangements can be made with Westmoreland Resources. The sub-Robinson zone is interpreted to be hydrologically separate from overlying aquifers based on decreasing potentiometric head with increasing depth. Therefore little impact is expected on the sub-Robinson zone as a result of mining.
AS	118.	Overgrazing remarks should be elaborated. How has productivity changed, if any? Where has overgrazing occurred? Perhaps the writer mistook concentration of cattle around a water source and recovering of previously farmed land for overgrazing. It is also possible that increased vehicular traffic, now heavy in section 36, has damaged vegetation. However, F.O.E. contends that the section-wide .38 aum/acre still stands, and that as such it is unreclaimable. How can DSL support the argument that reclamation will produce higher quality grazing than that presently available on the highest ranking state section?	AS. See discussion in letter by Oave Simpson of Westmoreland Resources.
AT	119.	Despite all the pious hopes, section 36 should not be sacrificed to an experiment. Less unique lands, as Gov. Judge pointed out on May 8, 1975, are available, in this case in Alternative Area 2 within Tract III and on Tract II, where the new dragline could be placed.	AT. The uniqueness of the subject Section 36 will be considered and evaluated prior to permit approval under the criteria and provisions provided in Section 50-1042 of the Reclamation Act.

120. Again, "comperable" is the key, and it is most arguably not possible.

121. Impact reductions herein described do not mitigate sufficiently to satisfy RCM 50-1042 and 1045. "Might" does not justify a permit in this case. (See p. 124 - "...elimination...irreversible...)

122. This section should discuss the 60-unit Romine trailer court cited above.

AX 124. This section is very much to the point. Again, spring 36 ACDC would be destroyed. Furthermore, potential impact upon potentiometric surfaces affecting spring 31 CCDB should be addressed.

AY 126. What coal may be recovered by underground mining as suggested here?

AZ 127. Prior issuance of the permit for section 25 will be litigated with the issuance of a permit for section 36, or earlier depending upon the disposition of the federal question, also a matter of future litigation.
Westmoreland should consider mining alternative area 2 and lands in Tract II. It is not necessary to terminate the operation, as suggested here, although failure to adequately address the issues could cause temporary cessation. This possibility could have been avoided if USGS and BIA had offerred to bring the public into the process after the Ninth USCA decision in Cady v. Morton. Having been left outside the process, we must now participate as best we can.

Remarks pertaining to eastern coal should be checked with Mr. Norman Kilpatrick, Surface Mining Research Library, P. O. Box 5024, Charleston, W. Va. 25311, area code 304, 342-0717 and 348-8928, who was not sent a copy of the DEIS in time to respond by the deadline.

BA 128. The deep mine safety argument should be reconsidered (see USGS FES response, p. 9, item 404, attached).
Complete coal recovery by vertical auguring should be considered, as described in the Billings Gazette, June 25, 1977.

BB 129. Energy conservation, cornerstone of the President's energy policy, should be considered along with other sources described by Jim Harding in appendix H, attached.

BC Appendix C, Page 1. Mrs. Vella Redding homesteaded with her family at Sarpy in 1916, not 1928. Otherwise, App. C is quite important to the implementation of RCM 50-1042 and 1045.

AU. The ultimate restoration to comparability will be dependent upon reclamation success if the permit is approved.

AV. No Section 50-1042 determination by DSL has been made as of the date of this EIS. The word might was used as the ultimate success or failure of reclamation efforts in a future occurrence.

AW. Refer to the above response AH.

AX. Please refer to III (A)(4)(b) in the text.

AY. The statement refers to any coal deposits that may be below the Rosebud-McKay and/or the Robinson seams.

AZ. No response required on the first part of the comment.

Refer to DSL response to Surface Mining Research Library letter of comment in this EIS regarding eastern U.S. coal.

BA. The text has been changed to reflect the information contained in the comment.

Refer to DSL response to comment on auger mining from Surface Mining Research Library in this EIS. Vertical augering at the present time is not in a commercial, feasible, state-of-the-art alternative.

BB. No comment required. This section refers to other forms of energy rather than other forms of energy conversion such as fuel cells, magnetohydrodynamics, etc.

BC. The text has been changed to reflect the information contained in the comment. No response required on the second part of this comment.

D Appendix D. Should include a list of plants similar to that in USGS FES, p. D-42.

Appendix G. Page 1. Is alluvium absent from the proposed mining area?
Page 2. As majority of inflow (likely to 220 gpm) is expected from the Rosebud-McKay overburden, a potentiometric map of the constituents of that aquifer is necessary. This data (10' drop at 1,000' in 3 years) does not appear consistent with its interpretation by DSL on p. 94, showing less than 1' drop at 1,000'. In fact, a complete re-reading of App. G seems in order. Given a drawdown of 10' at a distance of 1,000' within 3 years, and expanding, there seems to be considerable potential to affect springs beyond the proposed mining area, although mining within the presently permitted area has affected, thus far, only dry portions of the aquifers. Therefore, the proposed reserve area may be threatened by proposed mining of sections 24, 25 and 36. Quite obviously, such information as appears in appendix G, Dames and Moore, should have been developed prior to permitted expansion beyond the original five-year mining plan approved by Dept. of Interior, whose 1974 EIS was the baseline for DSL's original EIS and subsequent PERs. Information beyond the original 1974 EIS has not been reasonable developed until now, and is still inclomplete pending preparation of, e.g., potentiometric maps of the constituent strata of the Rosebud-McKay overburden. Further, Dames and Moore appendix G should have appeared within the body of Appendix C, USGS FES 77-17, as no comparable investigation for any portion of the proposed 20-year mining plan appears therein.

Page 4. How can drawdown in coal aquifers at a distance of 100' never exceed one foot, a level which would be reached in the first 140 days, as contended here?

BE Some discussion of the application of the 100' buffer zone should appear. Obviously it is not being applied in section 25 against Westmoreland's surface ownership, whether or not leased to someone else for other purposes, and even though that property is not completely paid for as yet. There does appear to be a buffer zone in section 36 against Crum's, even though Westmoreland has an option. Does DSL have hard and fast rules regarding buffer zones? What, if any, are they?

BF All blasting should be restrict in the morning hours to after 8:00 a.m.

BG FEIS should show a listing of all previous violations and fines incurred by Westmoreland Resources, along with a discussion of the remedial actions that may be taken for repeated or cumulative violations.

In conclusion Friends of the Earth requests that DSL consider all of the attached materials and that all appear in the public response section of the FEIS, including the June 15, 1977 response to USGS FES 77-17, as much of the material therein is applicable to section 36 and may be raised in litigation along with appendices A through L, attached thereto.

Most sincerely yours,

Edward M. Dobson

Edward M. Dobson
Northern Great Plains Representative

xc: Department of Interior
counsel
media

BD. A list of plant species has been included in the final EIS.

BE. The rules regarding the extent of buffer zones are flexible, and each situation is handled on a case-by-case basis dependent upon the findings and evaluations of DSL on the permit application. Please refer to MAC 26-2.10(10)-S10310(3).

Figure 1 in the Dames and Moore study shows that if a cut is made and left static it may be expected that after 1 year the drawdown at 1000' will be 1 foot and after 2 years it will be 10'. However, cuts do not remain static nor do they simply grow larger as far as the groundwater system is concerned, since each cut is filled with overburden from the next. The result is that the effective pit is constantly moving and a model such as that presented in the Dames and Moore study (Appendix G) is oversimplified.

The drawdown presented in the Dames and Moore study are maximum values based upon an excessive hydrolic gradient as mining proceeds data from observation wells will be constantly obtained. With a constantly expanding data base, the prediction of drawdown values will gradually become more exact.

BF. When and if the permit application is approved, the permit will include stipulations to the effect: during the months of April, May, June, July, August and September, all blasting is to be conducted during the hours of 8:00 a.m. to 8:00 p.m. During the months of September, October, November, December, January, February and March, all blasting is to be restricted to the hours between: one-half hour before sunrise and one-half hour after sunset, as determined by the United States Naval Observatory.

FRIENDS OF THE EARTH INC

July 25, 1977

TO: Environmental Coordinator, Department of State Lands
FROM: Edward M. Dobson, Northern Great Plains Representative
RE: Errata to Comments, DEIS, Westmoreland Expansion into Section 36

Page 1 (item 4), line 16, read...
DEIS constitutes a contribution...

Page 1 (item 4), line 20, read...
Appendix I, Jan. 7, 1976), and a state permit to mine outside the area...

Page 2 (new item 34), line 16, read...
Soils map should be accompanied by a key and descriptions, including (with map revised to show) reclaimed "soils" in section 25.

Page 2 (item 38), line 30, read...
Does DSL dispute springs 237 and 238's...

Page 2 (item 42), line 40, read...
available groundwater...

Page 3 (item 81), line 22, read...
East Fork...

Page 3 (item 91), line 44, read...
The low quality groundwater...

Page 4 (item 100), line 20, read...
not as great a disturbance as strip mining.)

Page 4 (item 106), line 57, read...
RCM 50-1042 and 1045 should be printed in their entirety.

Page 5 (item 115), line 20, read...
Since "It is not likely that much can be done...", at what point does air...

Page 6 (item Appendix G), line 50, read...
beyond the original 1974 EIS has not been reasonably developed...

Page 6 (item Appendix G), line 51, read...
still incomplete...

Page 7 (item Miscellaneous), line 10, read...
All morning blasting should be restricted to after 8:00 a.m.

Page 7, last line, read...
A through L, attached thereto. (This would seem to be a reasonable request in view of the frequently large hearings transcripts circulated by state agencies containing such bulk as, e.g., petitions.)

Appendix F (Matson), page 3, line 48, read...
the subsurface watering of this productive area (Sec.'s 27 & 28,

BG. Inclusion of the information requested is not deemed appropriate to the EIS and would add nothing to the substantive content of the EIS. The information is available for public inspection at the department's offices.

FRIENDS OF THE EARTH, INC. P. O. Box 882, Billings, MT 59103

July 27, 1977

To: Environmental Coordinator, Department of State Lands
From: Edward M. Dobson, Northern Great Plains Representative
Re: Addendum to Comments, DEIS, Westmoreland Expansion into Section 36
(Appendix M)

Condition of vegetation on Section 36

1. While pages 100-101 discuss possible future impacts of dust on reclamation, page 118 refers to "recent overgrazing" without mentioning other possible impacts, such as dust. Can "overgrazing" be documented?

2. In support of F.O.E.'s comment (item 118, page 5) concerning the impact of increased vehicular traffic upon the vegetation of section 36, enclosed are copies of (1) a recent article from the Billings Gazette quoting Montana rancher Frank Sparks, Plevna: "Driving a pickup over range for 1 2/3rds of a mile kills enough grass to feed a cow and calf for a month, he says," and (2) the Report of the Committee on Environment and Public Policy of the Geological Society of America, May, 1977, stating: "Tracks made by four-wheel vehicles are typically 18½ inches wide and, accordingly, disturb one acre in six miles of travel." (The impacts of continued travel are generally described in the Report.)

3. No environmental analysis of the present condition of vegetation on section 36 can be considered complete without taking into account the enormous damage caused this year by grasshoppers. By ~~mid~~ LATE July a walk across the section was much like walking across a skillet of popping corn.

Friends of the Earth maintains the .38 aum/acre evaluation, as to productivity, remains undiminished.

DSL RESPONSE TO LETTER

FROM

FRIENDS OF THE EARTH

July 27, 1977

1. No comment. See Westmoreland Resources' (Dave Simpson) response.

2. No comment required.

3. No comment required.

UNIVERSITY OF WISCONSIN–MADISON

Lewis G. Weeks Hall for Geological Sciences
1215 W. Dayton St.

Madison, Wisconsin 53706
Telephone 608 262-8960 8961

June 8, 1977

Mr. Edward Dobson
Northern Great Plains Representative
Friends of the Earth
P. O. Box 882
Billings, Montana 59103

Ed:

Attached are my belated comments relative to the U.S. Department of Interior's D.E.S. on the "Tract III" mining and reclamation plan. Due to my limited time, I have had to be brief. I only speak to selected hydrology-related portions of the D.E.S., not to your comments, or the comments of others, directly. However, I believe you will see that some of my remarks correspond to your previous criticisms of the D.E.S.

I will be out-of-state until mid July. Thereafter, if you would like to discuss this issue with me, I would be available for a phone call. If possible, on my next trip to Montana I will arrange a meeting with you.

Let me know if you wish the D.E.S. to be returned.

Sincerely,

David A. Stephenson
Professor of Geology

DAS/dcm

Attachment

Comments on the

Draft Environmental Statement

"Proposed 20-Year Plan of Mining and
Reclamation, Westmoreland Resources
Tract III, Crow Indian Ceded Area,
Montana"

by

D. A. Stephenson
Professor of Hydrogeology
University of Wisconsin
Madison, Wisconsin

These comments were made at the request of Mr. Ed Dobson, Friends of the Earth, and are based on reading the D.E.S.

1. There is an apparent discrepancy between the statement on page 7 that operators are bound not to pollute surface or ground waters and statements on page i. On the latter page it is stated that there will be degradation of ground and surface water quality and quantity. On page 351 the subject is put into perspective with comments that not all problems can be avoided. In short, there will be degradation of water quality and quantity; at issue is the magnitude and significance of this degradation.

2. Information given on Figure 2 does not correlate with the text on page 8. The text indicates a 20'-30' separation between the S-1 stray bed and the top of the Rosebud-McKay. Fig. 2 shows 70'-130' of separation.

3. Page 24 -- Is the proposed design of water control facilities sufficient at the 10-year frequency storm of 24-hour duration? What would be the impact of dam failure because of a storm of greater intensity? On page 248 the impact is dismissed as insignificant in relation to water quantity. What of down-stream water quality impacts due to dam failure?

4. Page 111 -- It is unclear how a ground-water flow system (which is a region of continuous hydraulic connection between recharge and discharge areas) can be separated by ground-water divides. If divides exist, then separate flow systems exist. The text on pages 111-112 is unclear. It is difficult to decide from the text if one or several flow systems prevail in the region discussed.

RESPONSE TO COMMENTS BY DAVID A. STEPHENSON

1. This comment does not require a response, however it should be emphasized that under the Montana Strip and Underground Mine Reclamation Act, water of adequate quality and quantity must be available for future uses.

2. Not pertinent.

3. There is some question concerning the adequacy of a structure to control the 10 year 24 hour precipitation event. The proposed interim regulations for the new Surface Mining Control and Reclamation Act of 1977 require that effluent limitation be met under the conditions of the 25 year 24 hour storm. The impact of a dam failure is discussed under III (A) (4) (a) (2) in the text.

4. The concept of a ground water divide refers to the direction water flows but does not indicate separate flow systems occur. Ground water flows in response to discharge points and corresponds roughly to topography, therefore the ground water divide referred to is largely a reflection of topography.

5. Pages 111-112 -- What is meant by a discontinuous zone of saturation? This implies vertical separation. Do perched aquifer systems exist, or is there merely relief on the water-table surface?	5. Not pertinent.
6. Page 116 and Figures 26 & 27 -- Since ground-water recharge is shown to occur annually to even sub-Robinson units, there is obvious good hydraulic connection from the water table to depths of several hundred feet. This suggests that any mining activity will disrupt flow systems substantially in and adjacent to the mined areas. Yet, on page 120, it is pointed out that fractures in the Rosebud-McKay overburden are rare. The discrepancy between what is observed on the hydrographs of Figures 26 & 27 and what is stated on page 120 underscores the highly variable nature of coal-field hydrogeology (as pointed out on page 109). This suggests that predicting impacts to water resources from mining is, at best, difficult. Thus, one might question conclusions within this D.E.S. relative to impacts to water resources as being either conservative or overstated. The hydrographs do seem to support the position that concluded impacts may be conservative.	6. The Department disagrees. Shale zones beneath the coal seams and different potentiometric heads for separate aquifers indicates there is hydrologic separation between aquifer zones. The text does indicate the complexity of making predictions relating to ground water impacts of mining.
7. A minor point, but on pages 121-122 the dimensions are mixed between English and Metric (units for transmissibility and permeability). For ease of reading, dimensions should be standardized.	7. Not pertinent.
8. Page 246 -- It seems reasonable to assume that the permeability of replaced spoil could decrease, even if porosity does increase. If so, then transmissibility would also decrease since it is a function of both permeability and aquifer system (or aquitard system) thickness. If infiltration increases as suggested, near-surface ground-water flow systems could become more active, thus altering stream and spring flow quality and quantity in adjacent areas. Thus, the statement on pages 248-249 that aquifers will be disturbed only during periods of mining seems to be too narrow a conclusion.	8. A concept of rubble zones occurring on the pit floor has been suggested as being the most permeable zone in the spoil mass that would transmit ground waters at a much higher rate than native materials. Predictions for post mining permeabilities made by Wayne Van Voast of the Montana Bureau of Mines and Geology (personal communication) are that spoils will have permeabilities with a median value slightly higher than the median permeability values for on coal native materials. No response is necessary to the second part of this comment.
9. Page 251 -- The mining impact on gradients includes diminishing gradients north of the proposed mine area. This will potentially decrease baseflow discharge to streams. Thus, statements such as on page 250, that overall reduction of flow in Sarpy Creek will not be significant, may be in error if tributary flow is considered.	9. Base flow contributed from the overburden and Rosebud-McKay aquifers will be greatly altered. Water originally from these zones should flow at the base of the final pit and re-issue at the outcrops or subcrop of the Robinson coal. The amount and timing of discharge of total base flow may vary slightly as a result of mining.

10. Page 252 -- The D.E.S. states that most existing wells are in the sub-Robinson unit and therefore will not be adversely impacted by mining. Whether or not most wells are completed in the sub-Robinson, those that are could be substantially impacted. The sub-Robinson aquifer may not be physically disturbed, but water quality within it could be altered (as suggested on pages 254 & 260). So also could water quantity in the sub-Robinson be adversely impacted given the unknown physical characteristics of replaced spoil through which some recharge to this deeper aquifer may have to occur.	10. As discussed earlier there appears to be hydrologic separation between the various aquifer zones and impacts should generally not be felt in the sub-Robinson zone.
11. Pages 259-260 -- Is the dilution potential down gradient sufficient relative to any potential trace element constituents that may have adverse health impacts? Monitor wells (page 336) are certainly useful in surveillance of water quality, but what are plans to remove ground water that did show an abnormal (and potentially harmful) content of trace elements? As described on pages 346 & 349, these questions may not be relevant for future use of near-surface ground water. But should there be concern for long-range, down-gradient impacts to health where ground water discharges to surface water? Again, this may be no problem, but I raise the question of whether trace element mobility in ground water, due to changed conditions of availability of trace elements in replaced spoil, has been adequately considered.	11. In general, an increase in dissolved solids is known to occur. Trace element levels in ground waters at individual mines vary and until this trace element information is gathered from spoils as they resaturate at the Absaloka Mine, it is impossible to evaluate the impact of trace element concentrations to the ground water system.
12. Page 370 -- The statement is made that any adverse impacts of lowered water levels cannot extend beyond the valleys of Sarpy Creek or East Fork Sarpy Creek can be questioned. Depending on present volumes of ground-water moving through the proposed mine area and discharging to surface water in these valleys, and the relation of this volume to total baseflow in these streams, some decline of water table across the streams could occur coincident to lowered streamflow.	12. Not pertinent to this EIS.

Proposed Expansion of
Westmoreland Resources Inc. Absaloka Mine
into Sect. 36 T. 1N., R. 37E.

Comments on the Draft Environmental Statement
Submitted by: Gary Matson
for Friends of the Earth
Box 308
Milltown, Montana

July 23, 1977

To: Environmental Coordinator
Department of State Lands
Capitol Station
Helena MT 59601

A. I have read the DES and have recently toured the "school section", which may also be referred to below as "the section". This area has characteristics that make it especially valuable both as livestock rangeland and as wildlife habitat.

B. Southeastern Montana's native range is characterized by an introductory statement in MSU Ag. Experiment Station Report 40 (page 5). "The rich vegetative cover of the study area is a prime natural renewable resource upon which a sound agricultural industry has developed over the years." The study area referred to in the statement is at the Colstrip Western Energy mine.

C. The springs and seeps on the school section contribute to the high quality of the rangeland there. The springs themselves provide excellent water with a low t.d.s. and do so on a year-round basis, even in dry years. The moisture in the coulees made available by springs and seeps creates conditions of sub-irrigation that result in high protein, digestible grasses even in dry seasons. The section has a productivity rate 46% higher than the average for 80 surrounding state sections. The information describing the environmental characteristics leading to the greater production capacity of the section is adequately presented in the DES and is repeated here for emphasis.

D. The moisture conditions that create a quality range are the same ones that create a quality wildlife habitat on the section. The surface and subsurface moisture have given rise to a diverse vegetation that provides both cover and food for a variety of wildlife. The "wet coulee" habitat is unique and is scarce among areas of southeastern Montana. It is impossible, however, to judge the true nature and extent of wildlife communities by reference to the inadequate encyclopedic listings and descriptions given in the DES. The unique combination of wet coulees with their lush growth of grasses, forbs, and shrubs, together with pine-covered breaks and drier upland grasslands surely supports complex animal communities. In order to better judge the value of the wildlife resource, there should be a much more thorough study of how the animal communities interact. That is, the "web of life" mosaic for the section needs much further study before it can be evaluated. The very diverse habitat suggests that it may indeed be both complex and rich.

DSL RESPONSE TO LETTER

FROM

FRIENDS OF THE EARTH

(Gary Matson - July 23, 1977)

A. No comment required.

B. No comment required.

C. No comment required.

D. No comment required.

E. In addition to agricultural and wildlife considerations, there is a third factor that has been largely ignored in the DES, and that is a human one. In all the listings of sewers, water, and health facilities, etc., there is no description of what real human life is like in the Sarpy area. The older among the ranchers chose to live in the Sarpy Basin because of its merits, and stuck with it even through the hard times of the thirties. They grew to depend on each other for both friendship and halp. There developed a strong bond of mutual trust, with gates, shops, and homes always open to a friend in need. They fostered a philosophy of productivity and a belief in the value of work and husbandry of land and animals.	E. No comment.
F. If strip mining is permitted in the school section, the productivity of the rangeland will be lost, the diverse wildlife community will be destroyed, and the people living in Sarpy will suffer further erosion of the standards they have established through many years of living with the land.	F. One of the purposes of the reclamation requirements is to return the mined area to a productive capability comparable to that which existed prior to mining. If DSL issues a permit it will have made a determination that it believes that the reclamation plan is capable of being fulfilled, given the information available at the time of the decision.
G. Attempts to mitigate impacts of strip mining have not been successful. The failure of reclamation to native rangeland can be amply demonstrated in all of Montana's strip mines, where there has been far too little time to permit any meaningful evaluation. Results to date are encouraging only in the sense that they have shown that some grasses do in fact grow under the right conditions on mining spoils. I toured Western Energy's "demonstration plot", and the adjoining study plots, where MSU Reclamation Research had been conducting studies since 1971. The "demo" plot had a moderately good stand of smooth brome grass, a non-native species. In addition, none of the adjoining areas showed any evidence of success in meeting the objectives that were subsequently presented in Research Report 40 (MSU Ag. Exp. Sta., 1973). For example, the Plant Community Development Study outlined on page 58 of the report had resulted by 1975 in a field of bare spots with the major grasses present being the annual brome grass invaders. Furthermore, the results of the Reclamation Research grazing study conducted at the Western Energy mine during the summer of 1976 indicate very strongly that grasses growing on spoils are inferior to native grasses in their ability to produce weight gains in cattle.	G. Although there have been isolated instances of revegetation failure, reclamation cannot, on the whole, be considered a failure at this point. Your statement that " . . . there has been far too little time to permit any meaningful evaluation" may be appropriate. Final determination of reclamation success or failure will be made following adequate time allowed to make such a decision.
H. Not only is reclamation of spoils to native range clearly unlikely according to current study results, but also the success in establishing any degree of plant diversity that might result in a return of wildlife to mined areas is doubtful. Plantings of shrub root pads and trees at Western Energy's "demo" plot as outlined in Research Report 40 largely failed, as I observed in my 1975 visit. On native range, diverse shrub growth is found mostly in coulees, where there is adequate moisture. The most likely reasons for continued failure of shrub plantings on spoils are that 1) moisture retention capacity of the soil is low and water passes rapidly down through, and out of, the root zone on the porous spoils, and 2) the altered chemical characteristics of the sometimes inverted and mixed overburden are hostile to the growth of some species.	H. The one instance of shrub failure should not be generalized to all mines - many alternatives are being pursued and additional information gathered. DSL concurs that shrub reestablishment is one of the more vital problems facing revegetation and encourages that it be a priority goal of mine reclamation.
I. The 46% above average production of the school section would be completely lost if mining were permitted. It is recognized that mining will destroy the sandstone and siltstone stratification responsible for the existence of the springs, and will instead create a more permeable jumble of fragments.	I. No comment required - refer to "F".

J. The people of Sarpy have already lost much that was their way of life. Blasting vibrations, dust, and noise are only physical evidences of an economic enterprise which has also created schisms between friends because of the new double standard brought to the land by coal mining potential. The county road with its gates open to all has been changed to a commuter corridor. Ranchers are afraid to leave equipment out or doors unlocked because of thefts. During my visit there in July of 1977, one house on the Sarpy Creek Road was looted while its owner was attending a wedding in town.

K. The impacts of mining upon rangeland, wildlife, and people are all adverse. None of them can be mitigated, and even range reclamation with its current status of occassional, revegetated spoils, must remain in doubt for the near future.

L. Montana can ill afford these impacts. Furthermore, mining in the proposed area would violate The Montana Strip and Underground Mine Reclamation Act (Title 50, Ch. 10, R.C.M. 1947), which states that "...certain lands because of their unique or unusual characteristics may not be strip mined..." The agricultural productivity of the school section as well as its diverse wildlife habitat provided by unusually moist conditions in the coulees are unique.

M. The mining plan of Westmoreland Resources for Section 36, T. 1N., R. 37E. should be rejected.

N. There is an abundance of coal in the eastern United States and there is increasing evidence that this coal, even with its high sulfur content, will be available for power generation as the nation proceeds towards the announced policy of requiring "state of the art" pollution control in all thermal electric plants. The State of Montana must avoid an over-dependance upon the coal resource as a source of income. Our present agricultural base is more compatible with the land values held by most Montanans and is permanent. We should avoid development that would cause the immigration of many people, only to encounter future economic stagnation when strip mineable coal is gone. The nation's energy needs can better be met by allowing eastern coals to play a larger role in thermal electric generation. The lower sulfur western coals will undoubtably continue to be used and, if not extracted at an excessive rate, will provide long term economic stability for the state.

D. A slower rate of strip mining could have these advantages: 1) less surface disruption, 2) better assessment of spoils reclamation efforts, 3) preservation of wildlife and scenic values, and 4) less disruption of the rural way of life which has been an important contributor to the moral backbone of America.

Gary M. Matson
July 23, 1977

J. No comment required.

K. Certain impacts can be mitigated, although to varying degrees of success. The statement that none of the impacts can be mitigated is incorrect, as the EIS lists a number of mitigation measures that will be employed. Ones' perception of impacts, whether adverse or desirable, is in many instances subjective.

L. Refer to DSL responses F and V to the Friends of the Earth letter of July 22, 1977.

M. The DSL will consider all pertinent plans and data prior to taking final action on the permit application.

N. Refer to DSL response Z to the Friends of the Earth letter of July 22, 1977, and to the DSL response to the Surface Mining Research Laboratory letter of July 25, 1977.

O. No comment required.

FRIENDS OF THE EARTH INC xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

P. O. Box 882
Billings, MT 59103
10 November 1977

The Honorable Leo Berry
Commissioner of State Lands
Department of State Lands
Helena, MT 59601

Dear Commissioner Berry:

As you are aware, Friends of the Earth submitted comments on the Westmoreland - State section 36 draft impact statement on July 22, 1977, including request for compliance with MEPA regarding springs and wells identification as well as potentiometric maps of the strata constituent to the Rosebud-McKay overburden. Subsequently, steps have been taken to provide such information and potentiometric maps, we understand, are being prepared.

However, it appears that it will not be possible for such groundwater information to be made available for publication in the final impact statement if present printing schedules are given priority over data availability. It would be a violation of the spirit and the letter of MEPA to forge ahead with a final impact statement while some of the key questions are only now being addressed. I am sure that once you have weighed the merits of compliance with MEPA against arbitrary printing and circulation schedules, you will agree that it is imperative that such critical information as is now being gathered becomes a part of the final impact statement. We look forward to continuing cooperation with you in these matters.

Best regards,

Edward M. Dobson

Edward M. Dobson
Northern Great Plains Representative

STATE OF MONTANA

DEPARTMENT OF STATE LANDS

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MINING

November 15, 1977

Mr. Edward M. Dobson
Northern Great Plains Representative
Friends of the Earth, Inc.
P. O. Box 882
Billings, MT 59103

Dear Ed:

I am in receipt of your November 10, 1977 letter regarding Westmoreland Resources' application of Section 36.

The department is aware of your concerns with the hydrologic information available on the area. Every effort has been made to secure the necessary data. As you know, the data base on Westmoreland's operations, as well as most other mines, is constantly expanding. As new information is obtained, it is incorporated into the department's decision-making process. However, at some point, the MEPA process must be concluded and a decision made. Westmoreland's application was submitted in June, 1976, and as your letter indicates, the draft EIS was distributed in June, 1977. During this time, you and other interested parties have participated in the review. An effort to conclude the process by December, 1977, certainly seems reasonable and well within the intent of MEPA.

The hydrologic situation at Westmoreland has been subject to much review by all parties. All parties' ideas on the matter have been analyzed and will be discussed in the final EIS. As you know, any information received by the department as part of an application is available to the public, and you are welcome to review it when it is received. As much information as possible will be included in the final EIS.

Sincerely,

Leo Berry, Jr., Commissioner
Department of State Lands